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SINGAPORE





# On a Collection of Mammals from the Natuna Islands, South China Sea

By F. N. CHASEN

The history of zoological exploration in the Natuna Islands has been summarized in two papers by Gerrit S. Miller<sup>1</sup> Jr., and Harry C. Oberholser.<sup>2</sup> Therein are bibliographies and general accounts of the island groups with, in the latter case, a map, all of which it would be superfluous to repeat, at so short an interval, in this place.

It remains to be recorded that V. Knight, late of the Raffles Museum, went to the islands for a short visit in November 1907 and made small collections on Sedanau, Bunguran and Midai: he revisited Bunguran for a few days in April 1909. No complete account of the material obtained has ever been published, and notice of a few of the more interesting mammals is therefore included below.

The next collection of mammals was made by myself. Taking advantage of facilities kindly offered by the Government of the Netherlands Indies I left Singapore on 16th August 1928, accompanied by three native collectors. We landed on the west coast of Bunguran, or Great Natuna Island, and collected from two camps, (20th August—12th September), one at Kuala Binjai, opposite Tanjong Belitong; and the other a short distance up the Binjai River which enters the Penarik River on its right bank near the mouth. These places are on the west side of Bunguran, facing the smaller island of Sedanau on which collecting was also carried out (13th—25th September). Several islets off the west coast of Bunguran were also visited. As I was unable to visit the southern islands of the group, Mr. P. M. de Fontaine, of the Raffles Museum, and three native collectors went there in 1931 (July—September) and collected on Sirhassen, Panjang, Berian and Subi.

The northern and southern groups of islands are by no means alike in their mammalian fauna. The southern group is essentially Bornean in its affinities. This relationship is primarily indicated by the presence of *Tarsius*, and *Tupaia tana* on Sirhassen Island, and is emphasized by the *facies*

1. "Mammals Collected by Dr. W. L. Abbott on the Natuna Islands", Proc. Wash. Acad. Sci., III, 1901, pp. 111-138.

2. "The Birds of the Natuna Islands", Bull. U. S. Nat. Mus., 159, 1932, pp. 1-137.

of the local forms of *Ratufa affinis*, *Tragulus kanchil* and *Tragulus javanicus*. The northern islands are also linked to Borneo by *Mydaus* which occurs in both places, but in general, the subspecies of Bunguran are dissimilar to those inhabiting the nearest Bornean mainland. In a number of cases they bear a strong resemblance, hitherto unrecognized as a general factor, to the races on Bintang Island in the Rhio Archipelago. Such are *Tupaia glis natunae*, *Rattus rattus luxuriosus*, *Sciurus notatus rubidiventris* and *Tragulus kanchil everetti*.

The present collection has enabled us to extend the range of some species within the island group. Specimens of the following mammals are recorded for the first time from the Natuna Islands.—*Rattus whiteheadi*, *Tarsius*, *Macroglossus*, *Rhinolophus trifolius*, *Hipposideros galeritus*, *Hipposideros diadema*, *Myotis adversus* and *Crocidura aagaardi*. The following subspecies of species already known to occur in the islands are also added to the fauna.—*Rattus surifer lingensis*, *Rattus mülleri firmus*, *Megaderma spasma trifolium* and *Rhinolophus borneensis nereis*. Furthermore, I have ventured to describe as new.—

*Rattus rattus luxuriosus* subsp. nov.

*Rattus sabanus bunguranensis* subsp. nov.

*Tragulus kanchil abruptus* subsp. nov.

*Tragulus javanicus abjectus* subsp. nov.

### **Pygathrix pyrrha vigilans (Miller).**

*Semnopithecus cristatus*, Thos. and Hart., Nov. Zool., I, 1894, p. 654 (Sirhassen); Miller, Proc. Wash. Acad. Sci., III, 1901, p. 138 (Sirhassen).

*Presbytis vigilans* Miller, Smiths. Misc. Coll., LXI, No. 21, 1913, p. 29 (Sirhassen Island, South Natuna Islands).

Sirhassen, 2 ♀.

This race was described from two skulls and the racial character given by Miller, like "other members of the *cristatus* group but region between narial aperture and middle of frontal more sloping" is confirmed by the present specimens as a good average character<sup>1</sup>. A few "*cristatus*" skulls in a long series are similar to *vigilans*.

In general colour the Sirhassen skins are very near an exceptionally dark example of *P. p. ultima* from Perak, Malay States, but much darker than normal well silvered continental animals. *P. p. vigilans* is also very close to some pale examples of *P. p. pullata* from Bintang Island in the Rhio Archipelago,

1. The greater apparent width i.e. that visible from above, and not the actual width (as supposed by Mr. Pocock in P.Z.S. 1934, p. 935) is a corollary of the more sloping face.

but the limbs are not so dark as in *pullata* though darker than the Perak example mentioned above.

(For measurements see page 30).

***Pygathrix siamensis natunæ* (Thos. and Hart.).**

*Semnopithecus natunæ* Thos. and Hart., Nov. Zool., I, 1894, p. 652 (Bunguran); II, 1895, p. 489 (Bunguran); Miller, Proc. Wash. Acad. Sci., iii, 1901, p. 138 (Bunguran).

Bunguran, 1 ♂, 2 ♀.

The three skins listed above are fairly uniform in colour. One has the entire tail black, but in the other two it is grizzled distally: there is never a pale streak on the underside.

This monkey is subject to a considerable amount of "bleaching" in life and the original description seems to have been drawn up from a specimen in worn pelage. Skins in good condition are brownish black on the back (between seal-brown and black of Ridgway): the lower parts of the limbs and the hands and feet are always considerably darker, and often quite glossy black.

The colour pattern on the thighs is that peculiar to all forms of the species. I doubt if any monkey of this group is other than white on the under parts when newly collected. Old and fatty skins usually turn buff in colour, and some preservatives also seem to have this effect. In the flesh, *P. s. natunæ* is quite white on the pale under parts (cf. Miller, Journ. Mamm. 1934, p. 133).

The slight difference between the arrangement of the hair on the head of *natunæ* and that of other races of *siamensis* does not seem of great importance. Whether or not the frontal hairs appear to radiate from one or two centres is largely a matter concerning the point of origin of the crest.

In *siamensis* the long, occipital tuft, or pad is usually preceded by a narrow, compressed, and median crest running down almost to the brow. This crest is formed by vertically growing hairs on the middle line of the forehead, and from its base, on each side, the frontal hairs diverge.

In *natunæ* the forehead is rather more bushy than in *siamensis* and an anterior prolongation of the crest is rarely well marked; when it is, and there is a median line of lengthened hairs, the frontal whorl is divided and an appearance of two radiating centres of hair is simulated.

"Face, grey; ears, muzzle and area round the eyes, fleshy. Palms and callosities, black." In one female the ears were grey.

This monkey is restricted in range to Bunguran, or Great Natuna Island where it lives in the heavy forest. The types came from Mt. Ranai in the east of the island and the present examples from the lowland forest on the west coast.

(For measurements see page 30).

*Nycticebus coucang natunæ* Stone and Rehn.

*Nycticebus tardigradus*, Thos. and Hart., Nov. Zool., I, 1894, p. 655 (Bunguran); op. cit., II, 1895, p. 489 (Bunguran); Miller, Proc. Wash. Acad. Sci., III, 1901, p. 138 (Bunguran).

*Nycticebus coucang natunæ* Stone and Rehn, Proc. Acad. Nat. Sci. Phil., 1902, p. 140 (Bunguran).

*Nycticebus natunæ*, Lyon, Proc. U. S. Nat. Mus., XXXI, 1906, p. 534 (Bunguran).

Bunguran, 1 ♀.

This specimen is very richly coloured and like some from Sarawak except that the under parts are largely tawny. In the skull there are four upper incisors, the two outer of which are very small and slender. The temporal ridges are well apart and the mastoid and audital bullæ are more inflated than in examples of *N. c. borneanus*.

External measurements (in the flesh).—Head and body, 274; tail, 16; hind-foot (s.u.), 62; ear, 20 mm.

Skull: greatest length, 56.9; basal length, 47.9; greatest width, 40.2; front of canine to back of last molar (alveoli), 20; least width between temporal ridges, 5 mm.

Note.—Mr. H. J. Baker has recently presented to the Raffles Museum a skin and two skulls of *Nycticebus* obtained on the island of Batam. These seem to be the first specimens recorded from the Rhio Archipelago and, although no actual topotypes of *N. c. bancanus* Lyon, described from Banka Island, are available for examination, the Batam animals are referred to that form as on description they are not separable, except that they have four upper incisors.

Excluding the northern race, *N. c. cinereus*, the Raffles Museum collection includes twenty-six skins of *Nycticebus*. They are easy to divide into three groups based on colour distinctions:—

The first-group consists of animals from the Malay States, south to Singapore Island, and Sumatra. All are relatively dull in colour.

The second group, including skins from Borneo, and one from the Natuna Islands, is much more richly coloured. The Natuna skin stands out by reason of its tawny under parts, but otherwise it is exactly like a skin from Sarawak.

The third group includes animals from the Rhio Archipelago. They are bright, like the Natuna skin, but have the vertebral stripe paler and brighter. The skulls of the specimens in this third group, which for the present I place under *bancanus*, in spite of the invariable four upper incisors, have the temporal ridges well separated.

The Batam animal (a male) measured in the flesh.—Head and body, 280; tail, 10; hind-foot, 58; ear, 19 mm. Two skulls from Batam measure.—Greatest length, 56.5, 58.3; basal length,

49, 49.6; greatest width, 39.6, 42.2; front of canine to back of last upper molar (alveoli), 20.2, 20.5; least distance between temporal ridges, 7.2, 5.3 mm.

**Tarsius bancanus** Horsf.

Sirhassen, 1 ♂.

This is the most interesting specimen in the collection providing as it does an entirely new locality for *Tarsius*.

That it represents an undescribed race is more than likely but the comparative material available is very poor and in view of the existence of Elliot's names and the uncertainty of the nomenclature (see Robinson and Kloss, Journ. Fed. Mal. States Mus., VII, 1919, p. 259) I cannot, at the moment, attempt a more precise determination.

Although agreeing in the distribution of hair on hands, feet and tail, in colour the Natuna skin is greyer and much less buffy in tone than two unsexed specimens from Sarawak, and it is more like an old mounted specimen from "British North Borneo".

The external measurements taken in the flesh by a native collector are certainly not accurate.

Skull: Greatest length, 36.7; occipito-nasal length, 34.8; front of *pmx.* to front of foramen-magnum, 26.5; front of *pmx.* to posterior extremity of palate, 15.4; least breadth between  $m^3$ - $m^3$  internally, 8.8; greatest length of bullæ diagonally, 11.7; greatest width of skull, 32; greatest breadth of braincase, 22; greatest length of upper molar row, 12.2 mm.

**Arctogalidia trivirgata inornata** Miller.

*Arctogalidia inornata* Miller, Proc. Wash. Acad. Sci., III, 1901, p. 131 (Bunguran Island, North Natunas).

Bunguran, 1 ♀; 1 ♂ (skin only, V. Knight coll., 1912); 1 ♂ (skull only, V. K., coll., 1909).

Both skins differ from a number of the Malayan *A. t. major* and the Bornean *A. t. stigmatica* in that the top of the head is not blackened. In the female the mid-dorsal stripe is faintly indicated as in some *stigmatica*, but three stripes are readily discernible in the male, in about the same degree as in less heavily marked examples of *major*, which, however, is normally much more heavily marked.

*A. t. inornata* is a small race.

External measurements (in the flesh) of a female.—Head and body, 450; tail, 455; hind-foot (s.u.), 70; ear, 35 mm.

Skulls of a male (given first) and a female measure.—Greatest length, 103.5, 92.6; condylo-basal length, 100.4, 90.2; median palatal length, 55.8, 48.7; zygomatic breadth, 61.7, 50.5; upper teeth, canine to last molar (alveoli), 35, 31.5 mm.

**Mydaus javanensis ollula** Thos.

*Mydaus meliceps*, Thos. and Hart., Nov. Zool., I, 1894, p. 657 (Bunguran); op. cit., II, 1895, p. 490 (Bunguran).

*Mydaus ollula* Thos., Ann. Mag. Nat. Hist. (7), IX, 1902, p. 443 (Bunguran).

Bunguran, 1 ♀.

Compared with two specimens of the Bornean race, *M. j. lucifer*, this example from Bunguran has a smoother coat and is more thinly haired. The white vertebral stripe is very thin and broken for a short space on the withers and on the base of the tail. The tip of the tail is white. There is only the slightest indication of a whorl on the nape, and on the surface of the pelage in that region no forwardly directed hairs can be detected. Both Thomas and Kloss<sup>1</sup> have pointed out the doubtful diagnostic value of the whorl and the colour pattern in this species.

The skull of the present specimen is smooth and rounded rather than "conspicuously ridged and angular", and although it may not be aged it is not immature. Similar skulls have been noted among Bornean examples by Lönnberg and Mjöberg<sup>2</sup>. As the tail is comparatively short there seems little to distinguish the Natuna race except the greater tendency to whiteness on the face and under surface. In the present specimen there are whitish hairs on the cheeks, a pale patch on each side of the neck, and a broad, but ill-defined pale area on the breast.

Maximum figures for the greatest length of the skull in Malaysian races of *Mydaus* seem to be.—

Males: *javanensis*, 97; *lucifer*, 105; *ollula*, 90.3 mm.

Females: *javanensis*, 82; *lucifer*, 89; *ollula*, 82.6 mm.

The Bornean race is therefore the largest and the Natuna race may prove to be rather smaller than *javanensis*.

*External measurements in the flesh*.—Head and body, 385; tail, 25; hind-foot (s.u.), 60; ear, 22 mm.

*Skull*.—Greatest length, 82.6; basal length, 72.7; zygomatic breadth, 38.6; mastoid breadth, 39.5 mm.

**Tragulus javanicus bunguranensis** Miller.

*Tragulus napu*, A. Everett in Thos. and Hart., Nov. Zool., I, 1894, p. 660 (reported from Bunguran).

*Tragulus bunguranensis* Miller, Proc. Wash. Acad. Sci., III, 1901, p. 113 (Bunguran Island, North Natuna Islands).

Bunguran, 1 ♂, 1 ♀.

This large, black-necked race has been discussed in detail by Miller: it is a very distinct form.

(For measurements see page 31).

1. Thomas, Ann. Mag. Nat. Hist. (9), XX, 1927, p. 288; Kloss, Journ. Mal. Br. Roy. Asiat. Soc., V, 1927, p. 348.

2. Ann. Mag. Nat. Hist. (9), XVI, 1925, p. 510.

**Tragulus javanicus abjectus** subsp. nov.

*Tragulus* sp., Miller, Proc. Wash. Acad. Sci., III, 1901, p. 115 (Sirhassen; two immature specimens).

**Type.**—Adult male (skin and skull), collected on Sirhassen Island, South Natuna Islands, on 29th August, 1931 by P. M. de Fontaine. Raffles Museum No. 2886.

**Diagnosis.**—Very near to *T. j. napu* of the Malay States and *borneanus* of British North Borneo, but smaller. In colour not separable from the paler, more buffy coloured examples of Malayan *napu*: also extremely close to the less blackened specimens of *borneanus*, but the nape stripe rather more obvious although still by no means well-defined.

**Specimens examined.**—The type and one immature male from Sirhassen Island.

**Measurements.**—See page 31.

**Remarks.**—Measured with the hoof, the hind feet of adult males of *T. j. napu* from the Malay Peninsula give a range of 146–154 mm. Animals of the same sex with the feet measuring 142–145 mm. are, judging by the teeth, immature. The above are collectors' measurements taken in the flesh: measured dry in the skin the feet of adult males give a range of 139–150 mm.

Adult females, according to the various collectors, have the feet measuring 150–152 mm.: dry measurements reduce this range to 148–150 mm.

In adults of *borneanus* the feet of males measure 142–150 (dry, 135–145 mm.); in females, 145–153 mm. (dry, 142–151 mm.).

The hind-foot of the adult male type of *abjectus* measures, dry 126 mm. The native collector who skinned the animals records 130 mm. for the same measurement in the flesh and this seems reasonable.

Malayan *T. j. napu* gives the following ranges for the condylo-basal length of the skull; adult males, 109–110 mm.; adult females, 106–112 mm.; an immature male, 100 mm.

• The same measurements in *borneanus* are 105–109 mm. for males, and 106.5–108 mm. for females.

The male type of *abjectus* has the condylo-basal length of the skull, 101.2 mm. The type is adult although the molars are not much worn.

**Tragulus kanchil everetti** Bonhote.

*Tragulus javanicus*, Thos. and Hart., Nov. Zool., I, 1894, p. 660 (specimens from Bunguran only); Thos. and Hart., op. cit., II, 1895, p. 492 (specimens from Bunguran only); Miller, Proc. Wash. Acad. Sci., III, 1901, p. 115 (Bunguran).

*Tragulus kanchil everetti* Bonhote, Ann. Mag. Nat. Hist. (7), 11, March 1903, p. 295 (Bunguran Island, North Natuna Islands).

*Tragulus natunae* Miller, Proc. Biol. Soc. Wash., XVI, 19th March, 1903, p. 38 (Bunguran Island, North Natuna Islands).



Bunguran, 4 ♂, 4 ♀.

This is a very bright race, more richly coloured, especially on the flanks, than the several races inhabiting the Malay Peninsula, Sumatra and Borneo; its nearest relative appears to be *rubeus* Miller, of Bintang Island in the Rhio Archipelago, for this latter race can only be separated on the average colour characters of a less blackened back and rather darker throat stripes. Lack of material prevents discussion here of comparative characters in the skull attributed to *everetti* by Bonhote and Miller in comparison with the Sarawak *hosei*.

(For measurements see page 31).

***Tragulus kanchil abruptus* subsp. nov.**

? *Tragulus javanicus*, Thos. and Hart., Nov. Zool., 1, 1894, p. 660 (Sirhassen "seen").

*Type*.—Adult male (skin and skull), collected on Subi Island, South Natuna Islands on the 4th August 1931, by P. M. de Fontaine. Raffles Museum No. 3799.

*Characters*.—A race belonging to the "cold" coloured section of *T. kanchil* and very different from the richly coloured *everetti* of Bunguran, *rubeus* of the Rhio Archipelago, and the races found in the Anamba Islands. In colour nearest to *klossi* of British North Borneo, but the nape stripe ill-defined and much less conspicuous, the thighs more rufous, the dark longitudinal throat stripes darker, and the white outer throat stripe broken by a well-defined band of colour which seems never to be present in *klossi*. *T. k. pallidus* Miller, of Pulau Laut, North Natunas, is paler and has the nape stripe well defined.

*Colour*.—Above, yellowish buff mixed with black, the black producing a clouded effect rather than the fine grizzle seen in most races of *T. kanchil*: the warm element entirely lacking on the flanks, which are greyish. Crown of the head, almost black, the nape stripe, grizzled and not conspicuous. Fore limbs, yellowish buff and a patch of tawny, or orange-tawny on the thighs. Dark throat stripes, mixed yellowish buff and black, the black predominating, but the transverse band mostly yellowish buff. Under parts, largely white, but there is a variously coloured central streak, and a thin buff line bordering the grey flanks.

*Skull and teeth*.—Although some races of *Tragulus kanchil* have been stated to possess distinctive subspecific characters the skulls of this isolated new form seem to present no peculiar features other than those of purely individual value.

*Measurements*.—See page 31.

*Specimens examined*.—Two (including the type), from Pulau Subi, South Natunas.

*Remarks*.—Whereas the smaller mouse-deer of Bunguran Island in the North Natuna Islands is very like a form occurring in the Rhio Archipelago, that inhabiting the South Natuna Islands is nearest to a Bornean race.

***Sus cristatus natunensis* Miller.**

*Sus* sp., Thos. and Hart., Nov. Zool., I, 1894, p. 660 (Bunguran); op. cit., II, 1895, p. 492 (Bunguran).

*Sus natunensis* Miller, Proc. Wash. Acad. Sci., III, 1901, p. 117 (Pulau Laut, North Natuna Islands; also from Lingung Island); Proc. U. S. Nat. Mus., XXX, 1906, p. 753.

Bunguran, 2 ♀.

Both adult with dentition complete. External measurements taken in the flesh.—Total length, 1258, 1221; tail, 166, 204; hind-foot with hoof, 223, 230; ear, 90, 102 mm.

*Skulls*.—Upper length, 282.5, —; basal length, 251, 260; zygomatic breadth, 128.5, 132; maxillary toothrow to front of canine, 112, 119 mm.

***Petaurista petaurista nitidula* (Thos.).**

*Pteromys nitidus*, Thos. and Hart., Nov. Zool., I, 1894, p. 660 (Bunguran); op. cit., II, 1895, p. 490 (Bunguran).

*Petaurista nitidula* Thos., Nov. Zool., VII, 1900, p. 592 (Bunguran); Miller, Proc. Wash. Acad. Sci., III, 1901, p. 121 (Bunguran).

No flying-squirrel is included in the present collection, but there is, in the Museum, a skin collected on Bunguran, in August 1894 by E. Hose. In colour this is duller and darker than any example of *P. p. melanotus* from the Malay Peninsula, or *P. p. rajah* of Borneo, in general tone standing between these two comparatively bright forms, and the dark *P. p. petaurista* of West Java, although nearest to *melanotus* on account of the pale face. The hands and feet are brown and scarcely darker than the remainder of the limbs.

The skull is small and measures.—Greatest length, 62.5; condylo-basilar length, 57; zygomatic breadth, 43.9; least interorbital breadth, 14.7; upper molar row (alveoli), 14.2; median nasal length, 17.5; greatest breadth of combined nasals, 12 mm. The nasals constrict in the centre more abruptly than in any skull in fair series of *P. p. petaurista*, or *P. p. melanotus*.

*Note*.—Two examples of this species obtained on Bintang Island, Rhio Archipelago, in June 1930, by some native collectors of the Raffles Museum, are the first specimens recorded from the Rhio Archipelago although the species was reported to occur on Batam Island.

The specimens, both males, are darker and duller than *P. p. melanotus* from the Malay Peninsula which form occurs on Singapore Island within sight of Bintang. They are larger than *P. p. nitidula* of Bunguran, and furthermore differ in the

possession of black hands and feet which contrast with the bright chestnut limbs. In one specimen the black areas are relatively small: the black tail tip is much reduced, and on the under side of the wrists and ankles, the black shows only as a narrow band. In this example the centre of the metacarpus is chestnut. In the other skin the black tail tip is larger, and the under sides of the limbs are mostly black.

On description the Bintang form cannot be separated from *P. p. batuana* Miller<sup>1</sup> (syn. *marchio* Thos.) which occurs on the mainland of Sumatra. *P. p. mimicus* Miller, of Pulau Rupert, East Sumatra, is a smaller subspecies.

*The skulls measure*.—Greatest length, 67.7, 68.6; condylo-basilar length, 60.7, 60.3; zygomatic breadth, 46.2, 45.9; upper molar row (alveoli), 15.8, 15.9; median nasal length, 18.8, 20.4; greatest breadth of combined nasals, 12.2, 13; least interorbital breadth, 14.7, 14.3 mm.

### *Ratufa affinis bunguranensis* (Thos. and Hart.).

*Sciurus bicolor bunguranensis* Thos. and Hart., Nov. Zool., I, 1894, p. 658 (Bunguran); op. cit., II, 1895, p. 491 (Bunguran).

*Ratufa bunguranensis*, Miller, Proc. Wash. Acad. Sci., III, 1901, p. 129 (Bunguran).

Bunguran, 4 ♂, 2 ♀.

The close relationship between this black-footed form and *R. a. personata* from the northern part of the Malay Peninsula has already been dealt with by Miller.

(For measurements see page 32).

### *Ratufa affinis sirhassenensis* (Bonh.).

*Sciurus bicolor albiceps*, Thos. and Hart., Nov. Zool., I, 1894, p. 659 (Sirhassen).

*Ratufa ephippium sirhassenensis* Bonh., Ann. Mag. Nat. Hist. (7), 5, 1900, p. 498 (Sirhassen).

Sirhassen, 4 ♂, 2 ♀.

It is difficult to see why Bonhote allied this subspecies with the North Natuna races from which it is very distinct. It is, as Miller remarks, much nearer to the Bornean races. No *R. a. ephippium* are available for comparison, but otherwise, in colour, the Sirhassen skins are most like pale examples of *baramensis* although still markedly paler.

(For measurements see page 32).

### *Sciurus prevosti navigator* (Bonh.).

*Sciurus prevosti*, Thos. and Hart., Nov. Zool., I, 1894, p. 659 (Sirhassen).

*Sciurus prevostii navigator* Bonh., Ann. Mag. Nat. Hist. (7), 7, 1901, p. 171 (Sirhassen).

*Sciurus navigator*, Miller, Proc. Wash. Acad. Sci., III, 1901, p. 129 (Sirhassen and Subi).

1. *Petaurista batuana* Miller, Smiths. Misc. Coll., xlv, 1913, p. 27 (Batu Islands, West Sumatra).

Sirhassen, 2 ♂, 1 ♀; Panjang, 4 ♂, 3 ♀; Subi, 5 ♂, 5 ♀.

In colour these skins are very near to red-footed individuals of *P. p. borneoensis*, but they are smaller and less deeply red below, and the tail is never so heavily grizzled. All the squirrels of this species from the various islands of the South Natuna group appear to belong to one race. The colour is rather variable. The tail is usually black, but in a few cases it is conspicuously grizzled with white. Most of the skins from Panjang are redder on the cheeks, thighs and feet than the three topotypes from Sirhassen, but both varieties occur on Subi and as the series examined from the other islands are not large, no further separation of subspecies seems advisable.

(For measurements see page 33).

### ***Sciurus notatus rubidiventris* Miller.**

*Sciurus notatus*, Thos. and Hart., Nov. Zool., I, 1894, p. 659 (Bunguran specimens only); op. cit., II, 1895, p. 491 (Bunguran specimens only).

*Sciurus rubidiventris* Miller, Proc. Wash. Acad. Sci., III, 1901, p. 127 (Bunguran Island, North Natuna Islands).

Bunguran, 11 ♂, 3 ♀.

*S. n. rubidiventris* is a very richly coloured form with dull feet and an especially broad, dark lateral stripe: it needs no comparison with the other races known from the North and South Natunas and the Anamba Islands, all of which are paler on the underparts. Judging by colour alone, the nearest relatives of *rubidiventris* are certain forms found in the south of the Malay Peninsula and in the Tioman and Rhio Archipelagos. Of these, *stellaris* of Bintang Island is certainly the nearest for even with good fresh series of both subspecies it is difficult to make any separation. *S. n. rubidiventris*, however, seems to be very constant in colour, and variation in tone on the under parts is almost negligible. Although some *stellaris* are absolutely inseparable from *rubidiventris* on colour, the Bintang race is more variable and some individuals are yellower, and others much redder below, than topotypes of *rubidiventris*.

(For measurements see page 34).

### ***Sciurus notatus rutiliventris* Miller.**

*Sciurus rutiliventris* Miller, Proc. Wash. Acad. Sci., III, 1901, p. 126 (Pulau Midai, or Low Island, Natuna Islands).

Sedanau, 1 ♂, 7 ♀.

A small form with the under parts bright, clear orange-rufous: smaller and decidedly paler than *rubidiventris* of Bunguran, and slightly larger and much more deeply coloured below than *lutescens* of Sirhassen. Compared with *lautensis* (specimens examined) the tail is darker with more conspicuous

annulations, the under parts redder and less tawny, the black lateral stripe more distinct and not grizzled with orange-buff.

No exact topotypes of *rutiliventris* are available for comparison but as the description fits very closely, no further separation is attempted.

(For measurements see page 35).

### **Sciurus notatus lutescens** Miller.

*Sciurus notatus*, Thos. and Hart., Nov. Zool., I, 1894, p. 659 (specimens from Sirhassen only).

*Sciurus lutescens* Miller, Proc. Wash. Acad. Sci., III, 1901, p. 124 (Sirhassen Island, South Natuna Islands).

Sirhassen, 8 ♂, 7 ♀; Berian, 1 ♂, 2 ♀.

The Sirhassen race of *Sciurus notatus* is remarkably small and, typically, extremely pale on the under parts. It seems not to demand any close comparison with any other race of *notatus*, but its nearest ally seems to be the Bornean subspecies, *dilutus*.

The range of variation in the fifteen skins is considerable although the original series is said by Miller to show no variation worthy of note.

The palest example is entirely without trace of ochraceous on the under parts which are, roughly, whitish tinged with pale buff on the middle line and on the inside of the thighs. In another phase the under parts are creamy buff. Other skins are tinged with ochraceous and the most deeply coloured animals are, in colour, exactly like some *dilutus* from North and East Borneo.

The three skins from Berian are all very bright below and two are separable from even the most brightly coloured Sirhassen skins by a slight reddish tinge on the under parts.

Berian, however, is so close to Sirhassen that without longer series it cannot be accepted that the two islands are inhabited by distinct subspecies even of this exceptionally plastic squirrel.

(For measurements see page 34).

### **Sciurus tenuis procerus** Miller.

*Sciurus tenuis*, Thos. and Hart., Nov. Zool., I, 1894, p. 659 (Bunguran); op. cit., II, 1895, p. 492 (Bunguran).

*Sciurus procerus* Miller, Proc. Wash. Acad. Sci., III, 1901, p. 122 (Bunguran Island, North Natuna Islands).

Bunguran, 7 ♂, 3 ♀.

The only character by which these specimens seem separable from typical *S. t. tenuis* of Singapore Island is that of the slightly smaller average size of the skull: in colour and body measurements the two forms seem exactly alike. The skulls of *procerus* listed above have the greatest length 35.5–36.4 mm., against 36–37.4 mm. in ten exact topotypes of *tenuis*: *tenuis* in

the south of the Malay Peninsula runs up to 38.2 mm. in the greatest length of the skull although such large animals are exceptional. In *S. t. parvus* of Borneo the skull attains a length of 41 mm.

(For measurements see page 35).

### ***Sciurus lowi natunensis* Thos.**

*Sciurus lowi*, Thos. and Hart., Nov. Zool., I, 1894, p. 659 (Sirhassen).

*Sciurus lowi natunensis* Thos., Nov. Zool., II, 1895, p. 26 (Sirhassen Island, South Natuna Islands); Thos. and Hart., tom. cit., p. 491, (Bunguran and Pulau Laut).

*Sciurus natunensis*, Miller, Proc. Wash. Acad. Sci., III, 1901, p. 123 (Sirhassen).

*Sciurus lingungensis* Miller, Proc. Wash. Acad. Sci., III, 1901, p. 123 (Lingung Island off southern extremity of Bunguran, North Natuna Islands).

Bunguran, 2 ♂, 3 ♀; Sirhassen, 2 ♂, 2 ♀.

The only appreciable difference between these specimens and a good series of typical *lowi* of Borneo is that the former have rather shorter skulls. It so happens that the Sirhassen animals are white below whereas those from Bunguran are washed with creamy buff, especially on the throat, but both phases occur in Borneo, and Miller states that his examples from Sirhassen and Lingung are alike in colour.

In a large series of typical *lowi* the audital bullæ are very variable in shape, and both conditions of the anterior lobes mentioned by Miller are found in skulls from Borneo, and from Bunguran: it seems therefore that *lingungensis* should be added to the synonymy of *natunensis*.

(For measurements see page 36).

### ***Rhinosciurus laticaudatus* subsp.**

*Rhinosciurus* sp., Miller, Proc. Wash. Acad. Sci., III, 1901, p. 131 (Sirhassen).

Bunguran, 1 ♂ juv.

This specimen is too young for a more accurate determination. There is no previous record of the genus from the North Natuna Islands.

### ***Rattus sabanus bunguranensis* subsp. nov.**

*Mus sabanus*, Thos. in Thos. and Hart., Nov. Zool., I, 1894, p. 658 (Bunguran); Miller, Proc. Wash. Acad. Sci., III, 1901, p. 121 (Bunguran).

Bunguran, 1 ♂, 2 ♀.

*Type*.—Adult female (skin and skull), collected on Bunguran Island, North Natuna Islands on 8th September 1928, by F. N. Chasen. Raffles Museum No. 665.

*Colour characters*.—A pale, dull form nearest to *R. s. ululans* of Sumatra (specimens from Bencoolen and Palembang), but

rather brighter, especially on the flanks thereby approaching the Malayan *vociferans*: much less yellow than typical *sabanus* and *vociferans* and needing no close comparison with the much blackened *strepitans* of the Anamba Islands, *stridens* of Tioman Island and, judging by description, with *fremens* of Sinkep and Lingga.

*Skull*.—The skull is in an interesting intermediate condition. It has the wide maxillary plate of *vociferans*, but the antorbital foramen is less contracted: at the same time this foramen is constricted below and less open than in typical *sabanus* of Borneo.

*External measurements*.—Head and body, 239; tail, 381; hind-foot, 45; ear, 27 mm.

*Skull*.—Greatest length, 56.2; condylo-basilar length, 48.1; diastema, 15.4; upper molar row (alveoli), 9.8; median nasal length, 22.3; interorbital breadth, 9.4 mm.; zygomatic breadth, 26.5; length of palatal foramina, 7.3 mm.

*Specimens examined*.—Four, including the type, and one collected on Bunguran in June 1912 by Mr. V. Knight.

*Remarks*.—Two specimens have the tail fairly evenly bicolored but in two others the distal portion is entirely white.

(For measurements see page 37).

### ***Rattus rajah hidongis* Kloss.**

? *Rattus rajah*, Miller, Proc. Wash. Acad. Sci., III, 1901, p. 121 (Specimens from South Natunas only).

*Rattus rajah hidongis* Kloss, Treubia, II, 1924, p. 122 (Sirhassen Island, South Natuna Islands).

Sirhassen, 1 ♂, 11 ♀.

In colour this rat is very like *R. r. rajah* Thos., of Borneo and *R. r. pellax* Miller, of the Malay Peninsula, but it has a shorter tail. It is immediately separable from the neighbouring *R. surifer* races, *lingensis* and *bandahara* by its duller, less yellow colour. Although the base of the under fur, and of the spines, is largely grey in the fresh pelage, Kloss appears to have been right in linking *hidongis* to *R. rajah* and not to *R. surifer* for in all the *hidongis* skulls there is a marked extension of the nasals beyond the fronto-premaxillary sutures. All the skins have the white of the under parts continuous with the pale feet, and no specimen shows a coloured gorget.

Without examination of the specimens it is impossible definitely to allocate to species "*Mus hellwaldi*" and "*Mus rajah*" listed by previous authors from various islands in the Natuna group. Two species now known as *R. rajah* and *R. surifer* are likely to occur together on any one of the islands.

(For measurements see page 38).

**Rattus surifer lingensis** (Miller).

? *Mus hellwaldi*, Thos. in Thos. and Hart., Nov. Zool., I, 1894, p. 658 (Bunguran).

? *Mus rajah*, Thos., Nov. Zool., II, 1895, p. 26 (Bunguran); Miller, Proc. Wash. Acad. Sci., iii, 1901, p. 111 (Specimens from North Natunas only).

*Mus lingensis* Miller, Proc. Wash. Acad. Sci., II, 1900, p. 206 ("Linga Island").

Bunguran, 11 ♂, 16 ♀.

In colour these rats are like *lingensis* as represented by examples from various islands of the Rhio Archipelago, but the tail is longer. The tails of adults from Bunguran give a range of 164 (1); 176–202 mm. with an average of 185 mm. This figure is only exceeded by five specimens in very long series from the Rhio Archipelago. But "*lingensis*" of East Sumatra also has a comparatively long tail, 171–205 mm. *vide* Lyon, with a high average of 192 mm. The tail length of the type of *lingensis* is given as 171 mm., and until measurements of a series of topotypes are available no further subspecific separation can be made. The Anamba subspecies has a very *short* tail.

The Bunguran skins have the spines and under fur grey. Only one specimen shows a trace of a coloured gorget. The white of the hind-foot is narrowly continuous with that of the inside of the thigh. The tail is bicolored and usually, but not invariably, also white distally.

(For measurements see page 38).

**Rattus whiteheadi batamanus** (Lyon.).

*Mus batamanus* Lyon, Proc. U. S. Nat. Mus., XXXI, 1907, p. 654 (Batam Island, Rhio Archipelago).

Sirhassen, 7 ♂, 2 ♀.

These examples from Sirhassen are very dull in colour, the backs comparatively dark, the under parts mostly grey, and never strongly ochraceous.

Of eighty-three skulls of typical *R. whiteheadi* from Borneo only four attain a length of 35 mm. and over. These four measure in their greatest length, 35, 35.1, 35.5 and 36.3 mm.

The five largest of eighty-eight Malayan skulls measure 35.1, 35.2, 35.3, 35.6 and 36 mm.

No skull of twenty Sumatran (excluding the east coast) specimens attains a length of 35 mm.

The South Natuna series, of which six perfect skulls measure 34.6, 35.1, 36, 36.2, 36.5 and 36.6 mm., therefore averages large and is accordingly placed under *batamanus* the type of which is said to measure 36.3 mm. in its greatest length of skull.

(For measurements see page 39).



**Rattus rattus pauper** (Miller).

*Mus neglectus*, Miller, Proc. Wash. Acad. Sci., III, 1901, p. 121 (Sirhassen specimens).

*Epimys rattus pauper* Miller, Smiths. Misc. Coll., LXI, No. 21, p. 13 (Sirhassen Island, South Natuna Islands).

Sirhassen, 3 ♂, 4 ♀; Panjang, 1 ♂, 2 ♀; Subi, 2 ♂.

Compared with the field-rat of Sarawak, South-west Borneo and Bandjermasin and with that of Sumatra and the Malay Peninsula this is a duller rat with the ochraceous element in the upper parts much reduced. Some adult Bornean skulls have the greatest length 40.5, 41, 42.7, 43.5, 44.7 mm.: *pauper* with a range of 39.6–42.3 mm. is therefore rather smaller. *Pauper* has also very small bullae. *R. r. mangalumis* Kloss<sup>1</sup> from Mangalum Island is very near to *pauper*. Like that form it is dull in colour, comparatively small, and has small bullae but it can be separated on its longer, narrower, more slit-like palatal foramina.

The skins from Panjang and Subi are rather darker than exact topotypes of *pauper* from Sirhassen and indeed are not separable from pale examples of the next race to be described but as they have the skulls of *pauper* they are placed under that name.

(For measurements see page 37).

**Rattus rattus luxuriosus** subsp. nov.

*Mus rattus* var., Thos. in Thos. and Hart., Nov. Zool., I, 1894, p. 658 (Bunguran).

*Mus neglectus*, Thos. and Hart., Nov. Zool., II, 1895, p. 492 (Bunguran); Miller, Proc. Wash. Acad. Sci., III, 1901, p. 121 (? Lingung and Midai specimens).

*Diagnosis*.—A dull coloured, white-bellied field-rat with the upper parts much darker than in *R. r. pauper* of Sirhassen Island, and exactly as in many examples, but not the darkest, of *R. r. rhionis* of Bintang Island, Rhio Archipelago. Larger than *pauper* (greatest length of skull, 42–44.1 mm., against 39.5–42.3 mm.) and with much larger bullae.

*Type*.—Adult male (skin and skull), collected on Bunguran Island, North Natuna Islands, on 3rd September, 1928 by F. N. Chasen. Raffles Museum No. 638.

*Specimens examined*.—Bunguran, 4 ♂, 3 ♀; islet of Pasir, off west coast of Bunguran, 2 ♂, 9 ♀; Sedanau, 6 ♂, 4 ♀.

*External measurements*.—Head and body, 176; tail, 166; hind-foot, 33; ear, 20 mm.

*Skull*.—Greatest length, 42.8; condylo-basilar length, 37.7; diastema, 12.2; upper molar row (alveoli), 6.7; median nasal length, 15.3; interorbital breadth, 6.7; zygomatic breadth, 20.9; length of palatal foramina, 7.8 mm.

<sup>1</sup> *Rattus rattus mangalumis*, Bull. Raffles Mus., 5, 1931, p. 88 (Mangalum Island, N. W. Borneo).

*Remarks.*—In its major characters of colour, size and condition of bullæ this rat is an interesting intermediate form between the field-rat of the South Natuna Islands (*R. r. pauper*) and that of the eastern islands of the Rhio Archipelago (*R. r. rhionis*).

(For measurements see page 37).

***Rattus rattus diardi* (Jent.).**

Sedanau, 2 ♂, 1 ♀; Sirhassen, 8 ♂, 4 ♀; Panjang, 2 ♂, 2 ♀; Subi, 1 ♂, 2 ♀.

The Malaysian house-rat, as variable in colour in the Natuna Islands as elsewhere, seems to be widely spread in the group. The largest skull is that of an adult male: it measures 44.7 mm. in its greatest length.

***Rattus rattus ehippium* (Jent.).**

*Mus ehippium*, Thos. and Hart., Nov. Zool., II, 1895, p. 492 (Bunguran).

Bunguran, 2 ♂, 1 ♀; Panjang, 12 ♂, 7 ♀; Sirhassen, 1 ♀.

These rats have been identified purely on the balance of characters: some are like "*concolor*" from the Malay Peninsula, but most have the palate rather broader. The largest skulls have been selected for inclusion in the table of measurements on page 38.

***Rattus mülleri integer* (Miller).**

*Mus integer* Miller, Proc. Wash. Acad. Sci., III, 1901, p. 119 (Sirhassen Island, South Natunas).

Sirhassen, 2 ♂, 1 ♀.

The measurements of the female are not included in the table on p. 39, for it is a very small animal (greatest length of skull 49.3 mm.) and possibly not full grown, although the teeth are slightly worn.

*R. m. borneanus* Miller, is very near to this form but large series of it from Sarawak and British North Borneo show that it is a distinct race. *Borneanus* is a brighter rat, noticeably so in series on account of the very bright individuals it occasionally throws up: few *borneanus* are as dull as *integer* and none is so finely grizzled. The tail is longer, but on account of the great variation shewn by the skulls the only constant character of separation from *integer* seems to be that of the larger bullæ.

(For measurements see page 39).

***Rattus mülleri firmus* (Miller).**

? *Mus integer*, Proc. Wash. Acad. Sci., III, 1901, p. 120 (specimen from Lingung).

*Mus firmus* Miller, Proc. Acad. Nat. Sci. Phil., 1902, p. 155 ("Linga Island").

Bunguran, 1 ♂.

The tail is longer than in *R. m. integer* of Sirhassen and the teeth and bullæ are noticeably larger. I cannot separate this single specimen from numerous examples of *firmus* from various islands of the Rhio-Lingga Archipelago, all of which, like the Bunguran specimen, are rather paler and yellower than the topotypes of *integer*.

(For measurements see page 39).

***Tupaia glis natunæ* Lyon.**

*Tupaia splendidula*, Thos. and Hart., Nov. Zool., I, 1894, p. 656 (Bunguran); Miller, Proc. Wash. Acad. Sci., III, 1901, p. 133 (Bunguran).

*Tupaia splendidula typica*, Thos. and Hart., Nov. Zool., II, 1895, p. 489 (Bunguran).

*Tupaia natunæ* Lyon, Proc. Biol. Soc. Wash., XXIV, 1911, p. 168 (Bunguran).

Bunguran, 1 ♂, 3 ♀.

This race is much more like the bright *T. g. castaneus* of Bintang Island than the duller forms from the nearer Anamba Islands, but it is readily separable from *castaneus* by its less deeply coloured under parts and shoulder stripe.

Authors have either definitely referred this race to *T. splendidula*, or have compared it with that form, which it closely resembles. Lyon treats *splendidula* as a full species inhabiting South Borneo, where, as specimens collected by Dr. W. L. Abbott seem to show, it occurs, in a few localities, together with *T. salatana*, which I regard as a subspecies of the widely spread *T. glis*. I have not seen *splendidula*, and my action in linking *natunæ* to *glis* may, therefore, be wrong, but it now seems certain that *splendidula* does not occur in the zoologically well explored northern parts of Borneo, and I hesitate to link the Natuna race to the more geographically remote of the two Bornean species. Furthermore, the status of *splendidula* as a full species seems to require further investigation for in South Borneo it would appear that it and *salatana* are largely mutually exclusive.

(For measurements see page 40).

***Tupaia tana sirhassenensis* Miller.**

*Tupaia tana*, Thos. and Hart., Nov. Zool., I, 1894, p. 657 (Sirhassen).  
*Tupaia sirhassenensis* Miller, Proc. Wash. Acad. Sci., III, 1901, p. 133 (Sirhassen).

Sirhassen, 4 ♂, 7 ♀.

The affinities of this race are with the races occurring in North and North-west Borneo. It is much less bright than *T. t. nitida* of West Sarawak and in general tone it is very near to *T. t. utara* from Mt. Dulit in North Sarawak and *paitana* from the territory of British North Borneo. *T. t. sirhassenensis*,

however, has the tail redder and less blackened than in *utara* and *paitana*. The grizzled pale area on the fore-back is more reduced than in *paitana*, but exactly as in *utara* which form *sirhassenensis* therefore most nearly resembles on the balance of colour characters. The cranial peculiarities of this form which have been described in detail by Miller are well marked in the skulls of the present series. While the measurements given below show that the Sirhassen form is indeed slightly smaller than *paitana* and *utara* they also show that the original series of specimens did not represent the maximum size of the subspecies.

(For measurements see page 40).

### **Crocidura aagaardi** Kloss.

? *Crocidura* sp., Thos. and Hart., Nov. Zool., I, 1894, p. 656 (Sirhassen).

*Crocidura aagaardi* Kloss, Journ. Nat. Hist. Soc. Siam, II, 1917, p. 283 (Patani, Peninsular Siam).

Panjang, 1 ♀.

This is a small, dark shrew with no brownish tinge and it is apparently not referable to any Bornean form. The skull is broken and an exact comparison is therefore not possible, but there seems no reason to separate this specimen from the Malayan animals described by Kloss as *C. aagaardi*.

*External measurements* (taken in the flesh).—Head and body, 91; tail, 60; hind-foot (s.u.), 14.5; ear, 10 mm.

*Skull*.—Upper tooth-row, 10.2; greatest breadth of rostrum, 7.0; mandible including incisor, 15.1 mm.

### **Galeopterus variegatus natunæ** (Miller).

*Galeopithecus volans*, Thos. and Hart., Nov. Zool., I, 1894, p. 657 (specimens from Bunguran only); Thos. and Hart., op. cit., II, 1895, p. 489 (Bunguran); Miller, Proc. Wash. Acad. Sci., III, 1901, p. 134 (specimens from Bunguran only).

*Galeopithecus natunæ* Miller, Smiths. Misc. Coll., XLV, 1903, p. 50 (Bunguran Island, North Natuna Islands).

*Galeopterus natunæ*, Thos., Ann. Mag. Nat. Hist. (8) II, 1908, p. 303 (Natuna Islands and Borneo).

*Galeopithecus variegatus natunæ*, Chasen and Kloss, Bull. Raff. Mus., 2, 1929, p. 17 (Bunguran and Anamba Islands).

Bunguran, 2 ♂, 2 ♀ (also 1 ♀, Bunguran, June 1894, coll. E. Hose).

The Bunguran form of *Galeopterus* was the first race of medium size to be described and on size alone can be distinguished from the larger races inhabiting Java, Sumatra and the Malay Peninsula. In colour both sexes seem exactly like the Malayan *peninsulae*, the sexual differences being very well marked. The males are rather richly coloured, but similar examples occur in Singapore: one specimen has the white spots on the upper parts unusually large.

The swollen lachrymal region noted by Miller in the type

of *natunae* appears to be only an individual character. It is noticeable in two skulls from Bunguran, but a similar condition is also found in other races of *Galeopterus*.

A race from South-eastern Borneo<sup>1</sup> has been described as *G. borneanus* but the characters given for its separation from *natunae* ("the interorbital constriction is wider, the brain-case decidedly wider, the nasals more pinched up into a ridge, and the rostrum deeper; audital bullæ of about the same size, the palate, posterior nares, and interpterygoid space decidedly wider in the Bornean form") seem essentially individual in this very variable animal. No exact topotypes of *borneanus* have been examined, but on the available material animals from Sarawak, British North Borneo and Banguay Island (North Borneo) are inseparable from *natunae*: in colour, size and cranial characters all seem essentially alike.

(For measurements see page 41).

### *Galeopterus variegatus gracilis* (Miller).

*Galeopithecus volans*, Thos. and Hart., Nov. Zool., I, 1894, p. 657 (specimens from Sirhassen only); Miller, Proc. Wash. Acad. Sci., III, 1901, p. 134 (specimens from Sirhassen only).

*Galeopithecus gracilis* Miller, Smiths. Misc. Coll., XLV, 1903, p. 49 (Sirhassen Island, South Natuna Islands).

*Galeopterus gracilis*, Thos., Ann. Mag. Nat. Hist. (8), II, 1908, p. 303 (Sirhassen); Chasen and Kloss, Bull. Raffles Mus., 2, 1929, p. 19: footnote.

Sirhassen, 2 ♂, 4 ♀; Subi, 1 ♂, 1 ♀.

A rigid comparison of these specimens with a good series of topotypical *G. v. aoris*<sup>2</sup> fails to reveal any character of size or skull by which the two forms can be separated.

The specimens of *aoris* of which measurements are included in the detailed table on page 42 and the summary of measurements on page 25 are all adult and were chosen from a larger series because in each case they appeared, by age, to be comparable with the examples of *gracilis* listed above.

Although the table shows that in both races the female is slightly the larger of the sexes it will be seen from the detailed measurements that one female of *gracilis* (greatest length of skull, 63.9 mm.) is almost identical in its major dimensions with a male of *aoris* (No. 214/12): nevertheless, it cannot yet be shewn that *gracilis* is a smaller subspecies. Turning to the fur we find that the female of *gracilis* is of the usual grey colour, the single skin from Subi being the palest of the series. The juvenile male from Subi is exactly like the pale grey female from the same island. One of the males from Sirhassen is also grey

1. *Galeopterus borneanus* Lyon, Proc. U. S. Nat. Mus., xl, 1911, p. 124 (South-eastern Borneo).

2. *Galeopithecus aoris* Miller, Smiths. Misc. Coll., xlv, 1903, p. 47 ("Pulo Aor, off coast of Johore").

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and cannot be separated from the females (this male is adult but as the teeth are unworn it is not included in the table of measurements). The other male from Sirhassen is certainly browner above than any female from that island, but it is less brown than the male of *aoris* and as Miller has stated that both the animals on which *gracilis* was founded are in the "grey phase" although they are sexed as male and female it seems that we have in *gracilis* a race in which the sexes are alike in colour, or not very different whereas in *aoris* the sexual dimorphism is well marked.

The acquisition of this series of *gracilis* proves that there is no foundation for the suggestions of Thomas (l.c.s.) and Chasen and Kloss (l.c.s.) that *gracilis* is the earliest name for a medium size race occupying the Natuna Islands and Borneo: it is a small race standing very near *aoris*.

(For measurements see page 42).

*Galeopterus variegatus* subsp. Summary of measurements given on page 42.

MEASUREMENT	MALE		FEMALE	
	<i>aoris</i>	<i>gracilis</i>	<i>aoris</i>	<i>gracilis</i>
Head and body (in the flesh) ..	316-327	300	345-379	327-360
Tail (in the flesh) ..	201-221	161 <sup>1</sup>	194-222	215-245
Hind-foot (dry, c.u.) ..	57-60	56	58-65	63-65
Ear (in the flesh) ..	16-19	20	19-20	16-24
<i>Skull</i>				
Greatest length ..	62-65.4	61.2	65.4(c)-69.1	63.9-69
Condyllo-basal length ..	59-61.8	58.2	63.4-65	60.8-66
Palatal length (lateral) ..	27.8-29.7	28.4	29.5-30.9	29.2-31.2
External biorbital breadth ..	40.2-40.6	41.8	40.8-42.4	40.5-43.2
Least interorbital breadth ..	18-16	14.9	15-15.9	15.7-17
Upper tooth-row (alveoli) ..	29.5-31.7	30.4	31.5-32.4	31.1-32.8
Palatal width at space between canine and first pre-molar ..	19.3-20.9	20	21.2-22.3	20-22.4

1. Examination of the skin suggests that this figure is too small: *Galeopterus* is a loosely made and rather difficult animal to measure in the flesh.

### *Pteropus vampyrus natunæ* K. And.

*Pteropus vampyrus*, Thos. in Thos. and Hart., Nov. Zool., I, 1894, p. 655 (Bunguran); Thos. and Hart., op. cit., II, 1895, p. 489 (Bunguran and Pulau Panjang); Miller, Proc. Wash. Acad. Sci., III, 1901, p. 137 (Bunguran).

*Pteropus vampyrus natunæ* K. And., Ann. Mag. Nat. Hist., (8), II, 1908, p. 369 (North Natunas; Sarawak).

Bunguran, 3 ♂.

This race does not differ from *P. v. malaccensis* in colour but it averages smaller.

The present specimens are all adult. The forearms measure 179, 190 and 193 mm. and the skulls, total length to gnathion, 75.7, 75, 72.5; palation to incisive foramina 36.5, 36.35; front of orbit to tip of nasals, 25, 24, 25; zygomatic width, 40, 41.5, 43.5; upper teeth c-m<sup>2</sup>, 28.5, 27, 28 mm.

*P. v. natunae* has not been recorded from the South Natunas.

***Pteropus hypomelanus annectens* K. And.**

*Pteropus hypomelanus*, Thos. in Thos. and Hart., Nov. Zool., I, 1894, p. 655 (Sirhassen).

"? *Pteropus hypomelanus*" (part.), Miller, Proc. Wash. Acad. Sci., III, 1901, p. 137 (Sirhassen).

*Pteropus hypomelanus annectens* K. And., Ann. Mag. Nat. Hist. (8), II, 1908, p. 361 (Sirhassen).

Sirhassen, 1 ♂, 1 ♀; Panjang, 1 ♂, 2 ♀; Subi, 1 ♂, 1 ♀.

This is an extremely thin race and I cannot detect the slightest distinction in colour, in any phase, even based on the series, between *annectens*, and *lepidus* from the various islands included in the range of that form by Andersen.

Skin for skin the South Natuna examples can be matched by selected specimens of *lepidus* collected on Pulau Tioman and elsewhere. But the teeth of *annectens* are usually rather smaller than in *lepidus* and the skull with a known greatest length of 59.2–65.5 mm. against 62.5–67.5 mm. in *lepidus* is also somewhat smaller.

In the following table the forearm measurements were taken from the prepared skins and can only be regarded as approximate.

LOCALITY	Sex	Forearm	SKULL					
			Total length	Zygomatic width	Upper teeth c-m <sup>2</sup> (alveoli)	Front of orbit to tip of nasals	Remarks	
								Adult
Panjang ..	♂	137	63	35.1	23.5	21.7	..	
Subi ..	♂	..	..	..	24.7	22	..	
Panjang ..	♀	..	59.2	31.6	22.5	20.2	..	
„ ..	♀	133	59.8	33.6	22.6	21	..	
Sirhassen ..	♀	129	..	..	22.6	20.1	..	
Subi ..	♀	..	59.7	31.4	22.3	20.3	..	

**Macroglossus lagochilus lagochilus** Matschie.

Sirhassen, 4 ♂, 2 ♀.

Forearms (adults).—♂, 40.6, 41.2; ♀, 41.7, 40.5 mm.

A *Macroglossus* skin taken on Bunguran, N. Natunas in June 1912, by Mr. V. Knight, has the nose much shrivelled and I do not care to proceed further with the identification: the forearm measures about 40 mm.

The bats of this genus are not common in Malaysia and there are few specimens in the Raffles Museum: they appear to be partial to mangrove swamps.

**Rhinolophus trifolius trifolius** Temm.

Bunguran, 1 ♂, 1 ♀.

Fur, brownish grey, wing membranes, bright brown, large yellowish spots on the elbows and knees. Free edge of the inter-femoral membrane tinged with yellow.

*Measurements*.—Forearm—, 49; 3rd metacarpal, 30, 33; 111<sup>1</sup>, 17.2, 19; 111<sup>2</sup>, 25.5, 28; 4th metacarpal, 35, 35; IV<sup>1</sup>, 11,—; IV<sup>2</sup>, 16, 16; 5th metacarpal,—, 37 (±); V<sup>1</sup>, 12, 13; V<sup>2</sup>, 17,—; lower leg, 23.5, 25; total length of skull (to front of canine), 22, 22.5; zygomatic breadth, 11.5, 11.5; upper teeth (to front of canine), 8.5, 8.9; mandible,—, 15 mm.

**Rhinolophus borneensis nereis** K. And.

*Rhinolophus nereis* K. Andersen, P.Z.S., 1905, p. 90; plate III, figs. 7, a, b, c. (Siantan Island, Anamba Islands).

Bunguran, 1 ♀.

Forearm, 46; 3rd metacarpal, 34; 111<sup>1</sup>, 13; 111<sup>2</sup>, 22; 4th metacarpal, 35; IV<sup>1</sup>, 9; IV<sup>2</sup>, 12; 5th metacarpal 35; V<sup>1</sup>, 10; V<sup>2</sup>, 10; lower leg, 21; tail, 18; total length of skull (to front of canine), 21; zygomatic breadth, 10.5; upper teeth (to front of canine), 8; mandible, 14 mm.

Andersen pointed out that *borneensis* of North Borneo occurs in the South Natunas in a form (*spadix*) only doubtfully separable from the typical race whereas in the more remote Anamba Islands certain modifications in structure appear, notably a decisive lengthening of 111<sup>2</sup> and a shortening of IV<sup>1</sup>. This form (*nereis*) forms a link between *borneensis* and *steno* of the Malay Peninsula and it is most interesting to find that it occurs in the North Natuna Islands.

**Rhinolophus borneensis spadix** Miller.

*Rhinolophus affinis*, Thos. in Thos. and Hart., Nov. Zool., I, 1894, p. 656 (Sirhassen).

*Rhinolophus spadix* Miller, Proc. Wash. Acad. Sci., III, 1901, p. 136 (Sirhassen).

Sirhassen, 15 ex. (♂, ♀).

The fur is either very bright in colour, near Sanford's brown, or duller and nearer russet.



The forearms measure 42.5–44.5 mm. and the ears 17–18 mm. The few examples of typical *borneensis* available for comparison have the forearm measuring 42–44 mm., and with a maximum forearm length of 46.3 mm. (*vide* Andersen, P.Z.S., 1905, p. 88) *spadix* seems to average very slightly larger but the material is scanty and the races need confirmation. Furthermore, the exact locality of the specimens of *spadix* with the longest forearms has not been stated and they may therefore be from the Karimata Islands, which Andersen included in the range of *spadix*, and not exact topotypes of the subspecies.

**Hipposideros larvatus** (Horsf.).

*Hipposideros larvatus*, Miller, Proc. Wash. Acad. Sci., III, 1901, p. 135 (Sirhassen).

Sirhassen, 3 ♀.

Forearms.—60.7; 62.7 mm.

**Hipposideros galeritus galeritus** Cantor.

Sirhassen, 1 ♂, 1 ♀.

Forearms.—49.8; 47 mm.

**Hipposideros diadema** subsp.

Bunguran, 1 ♀.

This single specimen with a forearm of 88 mm. in length is larger than any example of *H. d. vicarius* And. available for comparison and it also differs in that the fur is everywhere washed with orange.

**Pipistrellus subulidens** Miller.

*Pipistrellus subulidens* Miller, Proc. Wash. Acad. Sci., III, 1901, p. 135 (Sirhassen).

Sirhassen, 2 ex.

Although one of these bats has the inner upper incisors bifid, the others agree so closely with the description of *P. subulidens* that all are referred to that form. At the same time it must be stated that these Sirhassen specimens agree so closely with bats from Sumatra identified by the late Oldfield Thomas as *P. tralatitius* Horsf., that without a more detailed examination than is profitable at the moment in view of the confused state of this group in Malaysia they cannot be separated.

Forearms.—43.9, 43.6 mm.

**Myotis (Leuconoe) adversus** (Horsf.).

Sirhassen, 1 ♂.

Forearm.—38 mm.

MAMMALS FROM THE NATUNA ISLANDS

**Myotis muricola** (Hodgs.).

*Vespertilio muricola*, Thos. in Thos. and Hart., Nov. Zool., I, 1894,  
p. 656 (Bunguran).

Sirhassen, 2 ex.

Forearm.—32.4 mm.

**Megaderma spasma trifolium** Geoff.

Sirhassen, 5 ♂, 3 ♀.

Forearms.—♂ 57.7, 58.2, 59; ♀ 58.7 mm.

Not the larger *M. spasma natunae* And. & Wr., of Bunguran,  
North Natuna Islands.

*Pygathrix pyrrha vigilans* (p. 6). *P. siamensis natunae* (p. 7).

Species and locality	Sex	Head and body (in the flesh)	Tail (in the flesh)	Hind-foot, s.u. (in the flesh)	Skull				REMARKS
					Greatest length	Basal len- gth	Zygomatic breadth	Maxillary tooth-row with canine (alveoli)	
<i>Pygathrix pyrrha vigilans</i>									
Sirhassen ..	♂	525	790	155	94.4	69.5	74	30.9	Adult
" ..	♂	455	735	150	97.9	68.3	72.3	31.5	"
<i>Pygathrix siomenis natunae</i>									
Bunguran ..	♀	415	605	153	88.2	57.2	69	27	Adult
" ..	♀	455	625	150	88	58.4	69.5	27.5	"
" ..	♀	431	614	155	87.8	58.8	70.2	27.5	"

## MAMMALS FROM THE NATUNA ISLANDS

*Tragulus kanchil everetti* (p. 11). *T. k. abruptus* (p. 12). *T. javanicus bunguranensis* (p. 10).  
*T. j. abjectus* (p. 11).

Species and locality	Sex	Head and body (in flesh)	Tail (in flesh)	Hind-foot and hoof (dry)	Skull							REMARKS	
					Greatest length	Condylar-basal length	Palatal length (lateral)	Diastrama	Upper molar row (alveoli)	Median nasal length	Inter-orbital breadth		Zygomatic breadth
<i>Tragulus kanchil everetti</i>													
Bunguran	♂	415	60	115	94.7	87.6	50.4	7.5	35.2	28.5	26.8	43.9	Adult
"	♂	435	65	112	..	..	..	..	34.5	..	27.8	43	"
"	♂	468	62	120	95.4	90.2	51.9	10.1	33	28.4	27.5	44.3	"
"	♂	469	56	121	96.2	90.2	51.9	10.5	32.5	29.5	27.5	44	"
<i>Tragulus kanchil abruptus</i>													
Subi	♀	..	..	114	95.5	90.5	52.5	7.6	32.9	24.2	26.6	44.7	Adult [type]
"	♀	..	..	112	94.4	89.3	51.3	7.7	..	23.9	24.5	40.4	Post. molar erupting
<i>Tragulus javanicus bunguranensis</i>													
Bunguran	♂	513	72	138	112	102	59.7	10.2	39.7	30.3	30.5	47.4	Adult
"	♀	605	75	141	124	115.5	68.7	16.1	40.2	37.3	31.1	51	"
<i>Tragulus javanicus abjectus</i>													
Sirihassen	♂	495	70	126	107.5	101.2	60.1	10.5	36.5	30.4	29.3	47.8	Adult [type]
"	♂	..	..	120	94.2	88	50.7	8.8	22.5	29	26.7	43.4	Immature

*Ratufa affinis bunguranensis* (p. 14).      *Ratufa affinis sirhassenensis* (p. 14).

Species and locality	Sex	Head & body	Tail	Hind-foot, s.u.	Ear	Skull							REMARKS	
						Greatest length	Condylar basilar length	Palatilar length	Diastema	Upper molar row (alveoli)	Median nasal length	Interorbital breadth		Zygomatic breadth
<i>Ratufa affinis bunguranensis</i>	♂	305	385	68	26	61.6	51.9	23.3	12.6	11.9	20.4	23.7	37.5	Adult
	♂	315	400	66	25	64	53.3	24.3	13.3	12.3	21	25.5	38.7	"
	♀	310	370	67	24	61	51.2	22.7	12.7	11.8	19.1	23.2	38.9	"
	♀	315	410	69	25	65.9	54.4	23.6	13.9	12.7	22.4	27	42	"
	♀	305	375	71	24	62.2	51.3	24	13.7	12.5	19.2	24.8	39.5	"
	♀	320	380	70	27	63.3	53.6	24.2	12.7	12.8	19.2	24.6	39	"
<i>Ratufa affinis sirhassenensis</i>	♂	..	..	..	..	58.5	48.8	23	11.8	12.3	18.4	23	37.3	Adult
	♂	..	..	..	..	57.9	48.8	23.1	12.5	12	19	22.3	36.6	"
	♀	..	..	..	..	59.5	48.7	22.4	12.2	12.1	19	23.2	36.4	"
	♀	..	..	..	..	60	50.4	23.5	12.8	12	..	24.2	37.8	"
	♀	..	..	..	..	60.8	50.3	22.5	12.7	11.8	17.9	24.5	38.9	"
	♀	..	..	..	..	57.9	48.6	22.4	12.5	11.8	19.3	23.3	38.4	"

## MAMMALS FROM THE NATUNA ISLANDS

*Sciurus prevosti navigator* (p. 14).

Species and locality	Sex	SKULL							REMARKS			
		Greatest length	Condylor-basilar length	Palatilar length	Diastema	Upper molar row (alveoli)	Median nasal length	SKULL				
								Inter-orbital breadth		Zygomatic breadth		
<i>Sciurus prevosti navigator</i>	Sirhassen	..	♂	48.8	42.2	20.1	11	9.6	15	17.9	30	Adult
	"	..	♂	47.8	..	20.1	10.7	9	13.8	16.9	29.5	"
	"	..	♀	48.8	41.5	20.8	11.6	9.1	14.3	17.8	29.5	"
	Panjang	..	♂	49.9	42.4	21.9	11.9	10.4	14.2	19.3	29.1	"
	"	..	♀	49.4	42.2	20.4	11.2	10.4	14.3	19.2	29.7	"
	"	..	♀	49.5	42	22.6	11.8	9.7	14.2	19.2	29.6	"
	Subi	..	♂	48.2	41	20.1	11.5	9.1	13.2	18.3	28.5	"
	"	..	♀	48.6	42.2	20.2	11.1	9.5	14.1	18.2	29.5	"
	"	..	♂	50.2	43.5	21	11.7	9.1	14.2	19.4	30.1	"
	"	..	♂	48.7	42.2	20.5	11.1	9.4	14.4	18.4	29.1	"
	"	..	♀	49	42	20.7	11.2	9.4	14.4	18.3	27.7	"

*Sciurus notatus rubidiventris* (p. 13). *S. notatus lutescens* (p. 16).

Species and locality	Sex	Head and body	Tail	Hind-foot, (s.u.)	Ear	SKULL							REMARKS	
						Greatest length	Condylar-basilar length	Palatilar length	Diastema	Upper molar row (alveoli)	Median nasal length	Interorbital breadth		Zygomatic breadth
<i>Sciurus notatus rubidiventris</i>														
Bunguran	♂	207	158	41	15	51.5	44.1	22.7	11.6	9.4	15.6	19.2	32.2	Adult
"	♂	196	171	45	17	50.2	43.2	22.1	11.9	8.8	14.1	17.5	31	"
"	♂	198	173	45	16	51.4	43	22	11.3	..	14.5	18.5	30.2	"
"	♀	200	175	45	17	50.6	42.2	21.2	11.6	9.5	15.7	18.6	30.2	"
"	♂	195	165	44	19	50	42.2	21.5	10.9	9.3	15.5	18.4	30.1	"
"	♀	201	172	46	16	51.5	44	21.7	11.2	9.2	15.1	..	..	"
"	♂	194	178	47	17	51.3	43.8	22.3	11.9	9.2	15	18.6	31.4	"
"	♂	199	197	46	17	51.2	44.1	22.3	11.5	9.9	15	17.3	..	"
"	♀	200	160	45	15	51.9	43.7	22.5	11.8	9.6	15.5	17.6	30.8	"
"	♂	203	..	44	17	51.8	43.3	21.7	12.2	8.8	15	18.6	31	"
<i>Sciurus notatus lutescens</i>														
Sirihassen	♀	195	155	..	..	45.1	38.1	19	9.6	8.5	12.3	15.5	26.8	Adult
"	♂	180	162	..	..	45.2	38.2	19.2	10.5	7.9	12.8	15.6	27	"
"	♂	190	182	..	..	45.8	39.3	19.1	9.3	8.7	12.7	17.2	27.2	"
"	♂	190	160	..	..	46.5	39.1	19.8	10.2	8.5	12.8	15.9	27.4	"
"	♂	..	..	..	..	44.4	37.3	18.8	9.9	8.2	12.7	14.9	26.5	"
"	♀	168	162	..	..	45	38.7	19.8	9.7	9	12.4	15.8	25.7	"
"	♀	180	162	..	..	45.3	39	19.2	10.2	8.3	12.5	15.6	26.7	"
"	♀	..	..	..	..	44.5	38.5	18.8	9.1	8.7	12.6	15.3	25.6	"
Berian	♂	172	162	..	..	45.3	38.3	19.2	10	8.3	13.2	16.2	26.6	"
"	♀	195	165	..	..	46.7	39.2	19.5	10	8.8	13.9	16.4	27.4	"

## MAMMALS FROM THE NATUNA ISLANDS

*Sciurus notatus rutiliventris* (p. 13). *S. tenuis procerus* (p. 16).

Species and locality	Sex	Head and body	Tail	Hind-foot (s.u.)	Ear	SKULL							REMARKS	
						Greatest length	Condylar length	Palatilar length	Diastema	Upper molar row (alveoli)	Median nasal length	Inter-orbital breadth		Zygomatic breadth
<i>Sciurus notatus rutiliventris</i> Sedanau	♂	169	167	43	16	47.8	40.9	20.6	10.2	8.8	13.2	17	27.2	Adult
	"	175	160	42	14	48.5	40.2	20.4	11.1	8.2	14	16.5	28	"
	"	190	155	42	15	48.6	41.1	20.9	11.1	8.8	14.8	16.8	28.4	"
	"	194	164	43	15	50	41.9	21.2	10.8	9.2	14.9	17.4	29	"
	"	181	147	43	16	47	39.8	20.1	10	8.8	13.8	16.2	26.9	"
	"	191	164	45	17	50.4	42.4	21.2	10.9	9.2	14.3	16.7	28	"
	"	189	161	44	16	48.5	40.9	21	10.8	9	14.2	15.9	27.3	"
<i>Sciurus tenuis procerus</i> Bunguran	♂	128	105	81	14	36.4	29.6	14.6	7.8	6.3	10.6	12.5	22.2	Adult
	♂	134	..	83	14	36	29.7	14.9	7.5	6.7	10.5	12.6	22.3	"
	♂	135	102	83	13	..	30.1	15.7	7.8	6.5	10.2	12.4	..	"
	♂	133	110	80	13	35.5	29.1	14.4	7.2	6.2	9.5	11.9	21.5	"
	♂	122	108	82	13	35.9	29.1	14.5	7.5	6.5	9.7	11.8	21.7	"
	♀	135	98	29	13	36.3	29.7	14.7	7.7	6.3	10	13.2	22.7	"
	♀	125	107	30	13	36.1	29.4	14.9	7.8	6.4	9.7	22.4	22.6	"



*Sciurus lowi natunensis* (p. 17).

Species and locality	Sex	Head and body	Tail	Hind-foot (s.u.)	Ear	Skull								REMARKS	
						Greatest length	Condylar length	Palatilar length	Diastema	Upper molar row (alveoli)	Median nasal length	Interorbital breadth	Zygomatic breadth		
<i>Sciurus lowi natunensis</i> Bunguran	..	♂	132	91	32	15	37	30.7	15.1	7.9	7	10.5	11.1	21.5(c)	Adult
	..	♂	130	89	31	13	..	31.7	15.8	8.7	6.4	10.8	11.4	22.1	"
	..	♀	136	73	31	13	36.8	30.6	15.2	8.2	6.2	10.8	12.4	22.5	"
	..	♀	135	90	33	14	..	..	16.2	8.6	6.9	11.1	11.8	22.8	"
	..	♀	136	..	32	13	37.2	31.4	15.4	8.5	6.3	10.6	12.3	22.8	"
Sirhassen	..	♂	130	85	..	15	37	30.6	15.5	8.5	6.8	10.4	11.5	21.5	"
	..	♂	132	83	..	15	36.6	30.3	15.5	..	..	10.4	11	..	"
	..	♀	130	75	..	12	35.8	30.1	15.2	8.4	6.9	10.1	11	21.5	"
	..	♀	144	76	..	14	37.5	31.8	16.1	9	6.8	10.5	11.5	21.2	"

## MAMMALS FROM THE NATUNA ISLANDS

*Rattus sabanus bunguranensis* (p. 17). *Rattus rattus luxuriosus* (p. 20).  
*Rattus rattus pauper* (p. 20).

Species and locality	Sex	Head and body	Tail	Hind-foot, (s.n.)	Ear	SKULL							REMARKS		
						Greatest length	Condylor-basilar length	Diastrama	Upper molar row (alveoli)	Median nasal length	Interorbital breadth	Zygomatic breadth		Length of palatal foramina	
<i>Rattus sabanus bunguranensis</i>	♂	..	..	..	..	59.2	50.2	16	9.8	24.2	9.5	26.7	8.7	Adult	
	♀	247	346	44	28	56.5	48.6	14.9	9.5	21.8	8.7	26.4	7.6	"	
	♀	239	381	45	27	56.2	48.1	15.4	9.8	22.3	9.4	26.5	7.3	Adult [type]	
<i>Rattus rattus luxuriosus</i>	♂	182	..	31	20	43.1	37	11.8	7	15	6.4	19.8	7.7	Adult	
	♂	176	166	33	20	42.8	37.7	12.2	6.7	15.3	6.7	20.9	7.8	Adult [type]	
	♀	168	196	35	21	42	37.1	11.3	6.7	15.1	6.5	20.1	7.3	Adult	
	♂	178	182	32	21	42.8	37.7	11.2	7	15.3	6.2	20.7	7.5	"	
	♀	171	171	32	21	42.5	37.5	11.8	6.8	15.4	6.5	20.2	7.7	"	
	♀	190	175	34	22	43.7	38.4	12	7.2	15.2	6.5	20.8	8.2	"	
	♀	177	184	32	20	42.4	37	11.4	6.5	15.3	6.3	20.4	7.3	"	
	♀	169	191	33	21	44.1	37.9	12.1	7	16.5	6.8	21.8	7.5	"	
	♀	174	175	34	22	43.3	38.1	11.8	6.7	15.7	6.4	21.2	7.9	"	
	<i>Rattus rattus pauper</i>	♂	193	170	35	21	39.8	35.2	10.8	6.5	14.2	6.4	19	6.1	Adult
		♂	190	170	32	21	39.6	35.3	10.7	6.9	13.5	5.9	19.2	6.2	"
♂		183	162	34.7	22	40.7	34.9	10.5	7	13.8	6.2	20.3	6.7	"	
♀		185	170	33.8	21	40.3	35.6	11.3	6.5	14.2	6.3	19.8	6.7	"	
♂		167	180	35	20	41.2	35.8	11	6.5	14.9	6.4	18.6	6.4	"	
♀		170	160	34	19	42.3	36.7	12	6.7	..	6.5	19.5	6.7	"	
♀		..	..	..	..	39.5	34.5	10.1	6.6	13.9	6.2	18.4	6.3	"	

*Rattus concolor ephippium* (p. 21). *R. surifer lingensis* (p. 19).  
*R. rajah hidongis* (p. 18).

Species and locality	Sex	Head & body	Tail	Hind-foot	Ear	Skull							Remarks	
						Greatest length	Condylar length	Palatilar length	Diastema	Upper molar row (alveoli)	Median nasal length	Interorbital breadth		Zygomatic breadth
<i>Rattus concolor ephippium</i>														
Panjang	♂	121	128	24	17	32.2	26.8	14.2	8.2	4.9	11.8	4.8	..	Adult
"	♂	114	141	24	16	32.1	27.1	14.2	8.2	4.7	11.9	4.7	14.1	"
Panjang	♂	111	126	23	16	32.2	27.2	13.8	7.4	..	11.8	4.8	14.1	"
Bunguran	♂	131	135	23	17	32.8	27.6	14.5	8.2	4.9	11.8	5.1	15.5	"
<i>Rattus surifer lingensis</i>														
Bunguran	♂	208	202	42	25	50.5	42.2	20.7	13.2	7.8	18.7	7.5	23	Adult
"	♀	220	..	44	25	50.2	42	21.1	14.7	6.5	18	7.2	22.4	"
"	♀	191	185	40	24	..	38.2	19	12.8	6.4	17	7.4	21.4	"
"	♀	201	182	39	27	49.5	40.8	20.1	13.1	6.7	17.4	7.5	22.4	"
"	♀	210	..	40	25	48.2	40.2	20	13.2	6.5	18.9	7.4	21.9	"
"	♀	215	..	40	25	..	..	20.4	14.6	6.5	19	7.7	21.8	"
"	♀	200	..	39	25	47.9	40.5	19.4	13	6.7	17.1	7.5	22	"
<i>Rattus rajah kidongis</i>														
Sirhassen	♂	190	155	40	24	46	38.5	19.5	12.2	7.5	17.5	7.3	20.6	Adult
"	♀	205	..	39	24	47.4	39.1	19.7	12.5	6.9	19.3	7.3	20.5	"
"	♀	173	147	40	23	41.7	35.5	18.4	11.4	6.6	16.7	7.3	19.8	"
"	♀	173	137	39	20	40.6	34.4	17.6	10.4	7.1	15.6	7.2	19.3	"
"	♀	188	152	38	23	44.3	37	18.2	11.7	7.3	16.6	6.9	20.6	"
"	♀	215	170	35	..	47.5	40.5	21.1	13.5	7	18.9	8.1	20.5	"

## MAMMALS FROM THE NATUNA ISLANDS

*Rattus whiteheadi batamanus* (p. 19). *Rattus mülleri integer* (p. 21).  
*Rattus m. firmus* (p. 21).

Species and locality	Sex	Head and body	Tail	Hind-foot, (s.u.)	Ear	SKULL							REMARKS	
						Greatest length	Condylar length	Palatilar length	Upper molar row (alveoli)	Median nasal length	Inter-orbital breadth	Zygomatic breadth		Diastema
<i>Rattus whiteheadi batamanus</i>	♂	130	..	30	20	36	30.7	14.3	5.8	12.3	6.1	16.3	8.5	Adult
	♀	127	115	28	20	36.6	31	14.7	6	12.5	6.1	16.8	8.6	"
	♂	145	116	31	20	34.6	29.1	13.8	5.6	11.9	6.1	16.3	8.5	"
	♀	144	..	29	20	36.2	30.6	14.6	5.7	11.4	6.3	16.7	8.6	"
	♂	131	123	30	20	36.5	31.4	14.7	5.7	12.9	6	16.8	9.2	"
	♀	134	112	29	20	35.1	29.2	13.9	5.8	..	5.7	16.1	8.1	"
<i>Rattus mülleri integer</i>														
Sirhassen	♂	232	231	44	23	55.1	46.7	24.6	9.2	21.5	8.5	27.1	14.3	"
"	♀	230	225	45	26	53.6	46.2	23.9	9.3	22	7.8	25.5	14.3	"
<i>Rattus mülleri firmus</i>														
Bunguran	♂	232	270	49	24	..	..	..	10.2	..	7.8	..	..	"

*Tupaia tana sirhassenensis* (p. 22). *Tupaia glis natunae* (p. 22).

Species and locality	Sex	Head & body	Tail	Hind-foot (u. s.)	Ear	SKULL						Remarks	
						Greatest length	Basal length	Palatal length	Upper molar row (alveoli)	Tip of premaxilla to lachrymal notch	Interorbital breadth		Zygomatic breadth
<i>Tupaia tana sirhassenensis</i>													
Sirhassen	♂	219	..	46	..	60.5	52.4	33.5	17.2	29.3	15.5	28.2	Adult
"	♀	200	150	..	..	58.7	51	32.7	17.1	28.4	15.4	27.3	"
"	♀	209	133	..	..	58.2	50.2	31.6	16.7	27.6	15	27.2	"
"	♀	200	160	44	..	59.5	51.9	32.7	17.3	28.3	15.4	26.8	"
"	♀	210	155	40	..	59.8	51.8	33.1	18	29.2	15.4	27.8	"
"	♀	200	155	42	..	59.8	51.8	33	17.3	29	15.8	28.4	"
"	♀	211	162	41	..	57	50.4	32.2	16.4	26.8	14.9	26.6	"
"	♀	201	141	41	..	56.8	49.2	31.5	16.3	27.3	14.9	26	"
<i>Tupaia glis natunae</i>													
Bunguran	♂	181	141	39	18	..	..	..	16.5	..	14.7	26.8	Adult
"	♀	172	134	38	18	51.9	44.9	28	16.3	22.5	14.9	25.6	"
"	♀	177	139	40	16	52	44.2	27.5	15.8	22	14.5	25.6	"

## MAMMALS FROM THE NATUNA ISLANDS

*Galeopterus variegatus natunae* (p. 23).

Localities	Sex	Head & body (in the flesh)	Tail (in the flesh)	Hind-foot (dry, c. u.)	Ear from meatus (in the flesh)	SKULL							Remarks
						Greatest length	Condyllo-basilar length	Palatal length (lateral)	External alveolar breadth	Least inter-orbital breadth	Upper tooth-row (alveoli)	Palatal width at space between canine and first premolar	
Bunguran	♀	355	185	65	19	67	63.2	30.8	43.2	16	32	20.9	Adult
"	♀	375	190	67	20	68.5	66.4	32.6	45.8	17.2	33.4	22.4	"
"	♂	386	234	66	19	70.4	67.8	33.5	45.8	18.4	32.4	21.2	"
"	♂	400	280*	68	22	73.1	68.2	33.2	48.1	20.2	34	22.4	"
"	♂	..	..	..	..	..	68.2	..	43.6	18.2	31.4	20	"

\* This seems an exceptionally long tail, but the field-measurement taken in the flesh is confirmed by the skin.

*Galeopterus variegatus subsp. (p. 24).*

Localities	Sex	Head and body (in the flesh)	Tail (in the flesh)	Hind-foot (dry, c. n.)	Ear from meatus (in the flesh)	Skull						Remarks	
						Greatest length	Condylo- basal length	Palatal length (lateral)	External biorbital breadth	Least inter- orbital breadth	Upper tooth- row (alveoli)		Palatal width at space between first canine and pre-molar
<i>Galeopterus v. aoris</i>													
Aor	♂	322	221	58	16	65.4	61.8	29.7	40.5 (c)	16	29.5	20.9	Adult
"	♂	327	201	57	17	63.9	60	29.6	40.6	13	31.7	19.7	"
"	♂	316	216	60	19	62	59	27.8	40.2	15.8	29.6	19.3	"
"	♀	370	222	65	20	69.1	65	30.9	42.4	15	32.4	22.3	"
"	♀	345	209	58	19	65.4 (c)	63.4	30.1	40.8	15	31.5	21.2	"
"	♀	379	194	58	19	66.5	63.6	29.5	41.3	15.9	31.6	21.8	"
<i>Galeopterus v. gracilis</i>													
Sirhassen	♂	300	161	56	20	61.2	58.2	28.4	41.8	14.9	30.4	20	Adult
"	♀	327	225	63	21	63.9	60.8	29.2	40.5	17	31.1	20	"
"	♀	360	215	63	23	..	64.5	31.2	..	16.5	32.3	20.8	"
"	♀	350	245	64	24	69	66	30	43.2	17	32.6	21.2	"
Subi	♀	340	240	65	16	69	62.5	30.9	43.2	15.7	32.8	22.4	"

## Four New Races of Malaysian Birds

By F. N. CHASEN

### ***Anthreptes macularia natunensis* subsp. nov.**

*Characters*.—In colour most like *A. m. macularia* Blyth, of the Malay Peninsula, but the bill larger and the throat more finely marked.

*Type*.—Adult male, collected on Bunguran Island, North Natuna Islands, on 27th August, 1928, by F. N. Chasen.

*External measurements*.—Total length, 144; tail, 50; wing, 66.7; tarsus, 17; bill from gape, 23; culmen, 18.1 mm.

*Iris*, brown; bill, brownish black; feet, brownish green.

*Specimens examined*.—Six males from the type locality, compared with thirty-eight of the typical form.

*Wings*.—66.7, 67, 68,—, 68, — mm.

*Remarks*.—Large-billed races of sunbirds on small islands in Malaysia are usual. In the present case the smallest bill shewn by the Natuna series is about equal to that of most males from the Malay Peninsula.

### ***Stachyris nigriceps hartleyi* subsp. nov.**

*Characters*.—A pale, dull race, nearer to *borneensis* than to the Malayan (*davisoni*), and Sumatran (*larvata*) forms. Under parts less tinged with orange-buff than in *borneensis*; chin and throat slightly paler than in most *borneensis*; lores, forehead, and crown markedly paler, nearer to uniform grey and less variegated.

*Type*.—Adult male, collected on Mt. Poi, West Sarawak, 5,000 feet, on 20th October, 1923, by Dr. E. Mjöberg.

*Specimens examined*.—Five from Mt. Penrissen, 3,400–4,800 feet, and two from Mt. Poi, 4,350–5,000 feet, but of these, three skins, collected in 1899, have altered so much in colour that in *general tone* they are now inseparable from *borneensis*.

*Wings*.—64.5 (type), 62, 62, 62, 62 and 65 mm.

### ***Eurylaimus javanicus pallidus* subsp. nov.**

*Characters*.—Like *E. j. harterti* Van Oort, of North-east Sumatra, but paler on the head and under parts.

*Type*.—Adult male in the Raffles Museum, collected at Kao Nawng, Bandon, North-east Malay Peninsula, on 19th June, 1913, by H. C. Robinson and E. Seimund. Wing, 105 mm.



*Remarks.*—A bird from South Annam is very like two birds from the type locality of this new race. A large series from the Malay States is nearer to *pallidus* than to *harterti*.

***Pachycephala hypoxantha sarawacensis* subsp. nov.**

*Characters.*—Like *P. h. hypoxantha* Sharpe, from Mt. Kinabalu, North Borneo, but the under parts more uniformly yellow. In the typical form the throat and breast are washed with green: this darkening is much less noticeable in *sarawacensis*, especially on the sides of the breast.

*Type.*—Adult female in the Sarawak Museum, collected on Mt. Poi, West Sarawak, 5,200 feet, on 22nd October, 1923, by Dr. E. Mjöberg. Wing, about 83 mm.

*Specimens examined.*—Four specimens from Mt. Poi compared with fifty exact topotypes of the typical form.

*Wings.*—83, 86, 87, 88 mm.

## Two New Species of *Squilla* from Malayan Waters

By M. W. F. TWEEDIE, M.A.

(Plate I)

The two species of *Squilla* described below were collected during the year 1934 from Singapore and from localities on the Malayan coast of the Malacca Strait. One is a normal member of the group of closely allied species characterised by *S. oratoria* de Haan. The other belongs to the "*Chloridella*" group of the genus, but presents some peculiar features and appears to have no close ally among the species described.

I take great pleasure in naming the latter species after Dr. B. N. Chopra of the Zoological Survey of India.

The types will be deposited in the British Museum.

### *Squilla anomala* n. sp.

*Type*.—Adult male collected by a native collector from a seine net at Siglap, Singapore, June, 1934.

*Material*.—Four males and five females from Siglap, Singapore, 1934 ranging from 91 mm. (♀) to 58 mm. in total length.

One small male from Morib, Selangor.

*Description*.—This new species belongs to the group characterised by *S. oratoria* de Haan, and is very closely allied to *S. interrupta* Kemp. On purely morphological considerations it appears to occupy a position intermediate between this species and *S. oratoria inornata* Tate, but its resemblances to the latter subspecies are in my opinion fortuitous rather than indicative of close affinity.

As in *S. interrupta* the eyes are rather small the cornea being set obliquely on the stalk; the corneal index varies from 4.7 to 5.0 in specimens between 60 and 90 mm. in total length. In the shape and proportions of the carapace and rostrum and in the relative length of the antennular peduncles it is also in close agreement with *S. interrupta*, and the median carina of the carapace is interrupted at the base of the anterior bifurcation, just as in that species. The surface of the carapace and abdomen is distinctly pitted and rugose, but in a slightly less degree than in the allied species.

The most conspicuous feature that distinguishes it from *S. interrupta* is the condition of the dorsal margin of the raptorial carpus, which carries an elevated carina in place of the two tubercles characteristic of the other species, with which, however, it agrees in the sinuous outline of the outer margin of the raptorial dactylus. It is in the carina of the carpus that

this species most conspicuously resembles *S. oratoria inornata*, but this feature is not precisely the same in the two species: in *S. anomala* the carina terminates distally in a right angle, the termination sometimes appearing, from the lateral aspect, almost dentiform. In Tate's form the distal termination is obtuse in all the specimens in the collection of the Raffles Museum.

The lateral processes of the free thoracic segments and the form and ornamentation of the telson are as in *S. interrupta*, but in the bifurcate process from the basal segment of the uropods the margin anterior to the lobe on the outer edge of the longer spine is concave, as in *S. oratoria inornata*. It is of interest to note, however, that Hansen<sup>1</sup> records a specimen of *S. interrupta* in which this condition obtains.

The following abdominal carinae end in spines:

Carinae		Abdominal Somites
Submedian	.. ..	5, 6.
Intermediate	.. ..	4, 5, 6.
Lateral	.. ..	3, 4, 5, 6.
Marginal	.. ..	1, 2, 3, 4, 5.

The colours of the new species are not particularly distinctive. The dorsal surface of the carapace and abdomen is pale yellowish, and the chromatophores for the most part small and rather thinly scattered, appearing in spirit specimens as minute dots. Along the hinder margins of the segments they are more numerous, so that the segments appear to be narrowly bordered with grey posteriorly.

The telson and uropods are coloured much as in *S. interrupta*,<sup>2</sup> but the brown spot at the base of the median carina is absent or only faintly indicated.

Measurements of the male type:—

Total length	.. ..	88	mm.
Length of carapace and rostrum	.. ..	21	"
Anterior breadth of carapace	.. ..	9.5	"
Length of rostrum	.. ..	2.7	"
Basal breadth of rostrum	.. ..	3	"
Length of cornea	.. ..	4.2	"
Length of antennular peduncle	.. ..	16.8	"
Extreme length of raptorial merus	.. ..	16	"
Extreme length of raptorial propodite	.. ..	16.1	"
Extreme length of raptorial dactylus	.. ..	14.5	"
Length of telson	.. ..	16.5	"
Greatest breadth of telson	.. ..	16	"

1. Stomatopoda of the Siboga Expedition, 1926, p. 11.

2. See Tweedie, Bull. Raffles Mus., IX, 1934, p. 38.

## SQUILLA FROM MALAYAN WATERS

For convenience in identification a comparison in tabular form is given of this species, *S. interrupta* and *S. oratoria inornata*. It should be noted that this comparison is based on specimens in the collection of the Raffles Museum, taken in the neighbourhood of Singapore. In the case of *S. oratoria inornata* these seem to differ in certain minor features from the Indian specimens studied by Kemp.<sup>1</sup> In particular the second lateral abdominal carina almost always carries a spine (in about 10% of the specimens the spine is obscure or absent). In Kemp's diagnosis of this subspecies the lateral abdominal carinae 3 to 6 are quoted as spinate. Apparently in the typical *oratoria* the second is occasionally so.

Kemp gives no figure for the corneal index of the subspecies, but quotes 4.1 to 4.3 for specimens of the typical form 80 to 90 mm. in total length. Similar specimens in the present collection give a slightly lower index, *i.e.* their eyes are a trifle larger.

1. Memoirs of the Indian Mus., IV, 1913, p. 70.

<i>S. oratoria inornata</i>	<i>S. interrupta</i>	<i>S. anomala</i>
Eyes large, length of cornea considerably more than half anterior breadth of carapace. (Corneal Index 3.9-4.1). Antennular peduncle long, a trifle over twice anterior breadth of carapace. Length of rostrum a little more than basal breadth. Carapace narrow, median length, including rostrum, $2\frac{1}{2}$ times anterior breadth. Dorsal surface of carapace and abdomen punctate. Lateral abdominal carinae 2 to 6 end in spines. (2 is occasionally non-spinate). Outer margin of raptorial dactylus scarcely sinuous. Upper margin of raptorial carpus carinate, the carina obtusely angled anteriorly. In the bifurcate process from the base of the uropod the margin of the longer spine, anterior to the external lobe, is concave. Distal segment of the exopodite of the uropod conspicuously divided into inner blackish and outer light coloured halves.	Eyes small, length of cornea considerably less than half anterior breadth of carapace. (Corneal Index 4.8-5.2). Antennular peduncle short, considerably less than twice anterior breadth of carapace. Rostrum about as broad as long. Carapace broad, median length only a little more than twice anterior breadth. Dorsal surface of carapace and abdomen strongly pitted. Lateral abdominal carinae 3 to 6 end in spines. (2 is never spinate). Outer margin of raptorial dactylus distinctly sinuous. Upper margin of raptorial carpus bituberculate. This margin is convex.  Distal segment of the exopodite of the uropod light coloured except for a little black suffusion near the base of the inner margin.	As in <i>S. interrupta</i> . (Corneal Index 4.7-5.0).  As in <i>S. interrupta</i> .  As in <i>S. interrupta</i> .  As in <i>S. interrupta</i> .  As in <i>S. interrupta</i> , but to a slightly less degree. As in <i>S. interrupta</i> .  As in <i>S. interrupta</i> .  Upper margin of raptorial carpus carinate, the carina anteriorly rectangular. As in <i>S. oratoria inornata</i> .  Distal segment of the exopodite of the uropod similar to that of <i>S. interrupta</i> , but with a little more black suffusion; the inner half is never entirely blackish, as in <i>S. oratoria inornata</i> . As in <i>S. interrupta</i> .
On the dorsal surface of the carapace and abdomen the chromatophores are usually large and numerous, giving the animal a greyish, "peppered" appearance.	Chromatophores small, appearing as minute dots, so that the animal appears light coloured dorsally.	





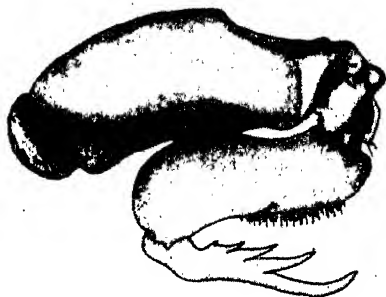
1



2



3



4



5

*Squilla choprai* n. sp. Plate I.

*Cotypes*.—Adult male and ovigerous female collected by a native collector from mangrove swamp at Port Swettenham, Selangor, F.M.S., December, 1934.

This species of *Squilla* has been found in some numbers inhabiting burrows among the roots of mangrove trees at the water's edge at Port Swettenham, Selangor, and near the mouth of the Serangoon river, Singapore Island.

At the Singapore locality the salinity of the water must decrease appreciably when there is heavy rain, but the specimens from Port Swettenham were all taken along the shores of mangrove covered islands in an environment that would scarcely ever be subject to any such influence.

*Material*.—A number of specimens were collected in both localities, ranging from post-larval juveniles of about 12 mm. to adults nearly 60 mm. in total length. Several of the females from Port Swettenham are ovigerous, and from a burrow in Singapore a number of larvæ were obtained which must be presumed with a fairly high degree of certainty to belong to the present species.

*Characters*.—A species of *Squilla* of the "*Chloridella*" group, characterised particularly by the ischio-meral articulation of the raptorial limb, which is not terminal but situated slightly in advance of the proximal end of the merus.

*Description*.—The dorsal surfaces of the carapace and abdomen are smooth and polished. The carapace has the triangular shape typical for species of the "*Chloridella*" group of *Squilla*, being about half as broad anteriorly as posteriorly. Two pairs of carinæ are present on the carapace. The marginal ones are developed only in their posterior reflexed portions, but are there very distinct. In addition there is a pair of low carinæ commencing near the anterior margin and running just outside and parallel to the gastric grooves. These carinæ are interrupted by the cervical groove and become obsolete just behind it.

The antero-lateral angles of the carapace are directed obliquely outwards and, in the larger specimens only, carry a small spine. The anterior border slopes very distinctly forwards to the base of the rostrum on either side.

The rostrum is much broader at the base than it is long, and is triangular in form with the apex rounded.

The eyes are short and broad and reach to less than half the length of the basal segment of the antennular peduncle. The breadth of the corneæ is considerably less than the maximum breadth of the eye-stalks, which have their inner margins straight and apposed for most of their length and their outer margins strongly convex.



The antennular peduncle is stout and its three segments are together equal to about the length of the carapace and rostrum.

A small mandibular palp is present, and epipodites are present on the first four thoracic limbs.

The structure of the raptorial limb is remarkable in that the articulation of the ischium and merus is not terminal, as in normal members of the genus, but situated slightly in advance of the proximal end of the latter joint.

In Kemp's diagnosis of the genus *Squilla*<sup>1</sup> the terminal situation of this articulation is cited as a generic character, being one of the features separating *Squilla* from *Odontodactylus* and *Gonodactylus*. The present species, however, approaches neither of these genera in any other respect, and in the rest of its anatomy is a typical *Squilla* of the "*Chloridella*" group.

The merus is thick and massive, and its inferior margin, anterior to the ischial articulation, is concave. The carpus is also large; on its dorsal surface, near the meral articulation, it bears two partially divided tubercles, of which the outer is by far the larger. Distally the upper margin of the carpus is defined by a strong carina which curves sharply outwards at its proximal end and terminates distally in a dentiform lobule, from which springs a tuft of stiff hairs. The propodus is broad and much shorter than the merus and its lower margin is strongly sinuous. Its upper margin is pectinate, but less finely than is usual in the genus, and the teeth are interspersed with stiff hairs. The usual three moveable spines just inside the proximal part of the upper margin are short. The dactylus carries five spines on its upper margin of which the terminal one is the largest and the first is minute; the edges of the spines are very finely lacinate. The lower margin of the dactylus is sinuous.

In the last three thoracic somites the intermediate carinæ are distinct, but do not completely traverse the terga. The fifth thoracic somite does not possess a pair of inferior spines and bears only a faint ridge on the outer part of its upper surface.

The first five abdominal somites bear faint intermediate, lateral and marginal carinæ of which the only ones ending in spines are the intermediates of the fifth. The last abdominal somite bears, in addition, submedian carinæ, and both these and the intermediate and lateral carinæ end in spines.

The dorsal surface of the telson carries a strong median carina, which ends in a small spine, and short, thick carinæ opposite the submedian, intermediate and lateral teeth. In addition there are a number of tubercles whose arrangement is characteristic and shows little variation. These tubercles are

1. Mem. Ind. Mus., IV, 1913, p.

## SQUILLA FROM MALAYAN WATERS

more strongly developed in the female, but in the male the marginal carinæ are considerably inflated. The surface of the telson is granular, and those of the carinæ and tubercles somewhat rugose.

The submedian teeth carry moveable spinules, the intermediates, and laterals, are not spinate and their external margins are carinate. There are constantly one lateral and five intermediate denticles, but the submedians are variable, numbering from two to three pairs in small specimens and tending to become obsolete in large ones.

The under surface of the telson is quite smooth, without a trace of a post-anal carina.

In the uropods there are only four moveable processes on the outer margin of the proximal segment of the exopodite. The two proximal ones are normal spinules, the penultimate is a little flattened and the last is a relatively large, spatulate process. Both the spines of the bifurcate process are directed upwards, and there are from five to seven (usually six) spines along its inner margin. There is also a spine on the upper surface of the basal joint, near its articulation with the exopodite.

The prevailing colour of the animal is olive green. The carapace is irregularly suffused with grey and blackish, and there is a black spot on either side of the median line of each of the thoracic and abdominal somites. On the sixth abdominal somite these spots may be absent, and when present are closer together than on the fifth. The posterior borders of the somites are narrowly bordered with blackish. The telson is green, and the uropods are greenish proximally and light brown distally, with the distal half of the proximal segment of the exopodite black.

Measurements of the male type:—

Total length	..	..	59	mm.
Length of carapace and rostrum	12.4	..	..	..
Anterior breadth of carapace	..	5.5	..	..
Posterior breadth of carapace	..	10.7	..	..
Length of rostrum	..	1.5	..	..
Basal breadth of rostrum	..	2.2	..	..
Length of eye	..	2.7	..	..
Greatest breadth of eye	..	1.6	..	..
Breadth of cornea	..	1.1	..	..
Length of antennular peduncle	..	12.2	..	..
Length of raptorial merus	..	15.5	..	..
Length of raptorial propodus	..	11.4	..	..
Length of raptorial dactylus	..	10.4	..	..
Length of telson	..	9.5	..	..
Greatest breadth of telson	..	12.5	..	..

*Larval forms.*—A series of eleven larvæ was obtained from a burrow in the Serangoon River, Singapore. They are probably all members of the same brood, and are about 5 mm. in length, measured from the tip of the rostral spine to the telson.

The carapace is vaulted and carinate in the middle line. It carries a long spine at each of the postero-lateral angles and a slightly shorter one in the middle of the posterior border. Between this and the postero-lateral spines the two halves of the posterior border are somewhat sinuous. The antero-lateral angles are spinate. Just behind them there is a small spinule, and four more spinules along the posterior half of the lateral margins, the last of which is directed downwards.

The rostral spine is short and does not reach quite to the end of the antennules.

The eyes are large and pear shaped, with slender stalks.

In the raptorial claw the dactylus is not toothed, but the upper margin of the propodus is finely denticulate and bears a larger spine near its base.

The telson is longer than broad; its sides are slightly curved and not much convergent posteriorly, so that the posterior margin is rather wide. This margin carries 14 very minute denticles (the submedian denticles). The submedian teeth, situated at the postero-lateral angles of the carapace, are relatively long. The lateral margins have five spinules between the submedian and intermediate teeth, but apparently none between these and the lateral teeth.

The uropods are very small and inconspicuous.

#### EXPLANATION OF PLATE I

##### *Squilla choprai* n. sp.

- Fig. 1. Carapace and Ophthalmic segment.
  - Fig. 2. Telson of Male.
  - Fig. 3. Telson of Female.
  - Fig. 4. Right Raptorial Limb.
  - Fig. 5. Exopodite of Right Uropod.
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## Notes on the Genus *Ilyoplax* Stimpson (Brachyura, Ocypodidae)

By M. W. F. TWEEDIE, M.A.

(Plates II, III)

The genus *Ilyoplax* was founded by Stimpson<sup>1</sup> for the species *I. tenella* from the Canton River in 1858, the type of which is no longer extant.

In 1888 de Man<sup>2</sup> founded the genus *Dioxippe* to accommodate *Cleistostoma pusilla* de Haan and a new species from Mergui, which he named *Dioxippe orientalis*.

Rathbun<sup>3</sup> in 1897 showed that *Dioxippe* was preoccupied and proposed the name *Tympanomerus* for the genus. In 1921 the same author,<sup>4</sup> in a footnote to her description of *Ilyoplax formosensis*, considered that *Tympanomerus* and *Ilyoplax* were inseparable, the latter name having priority.

The last comprehensive survey of the genus is that given by Kemp<sup>5</sup> in 1919 in which he gives a key to eleven species, including three new ones, and *Cleistostoma lingulatum* Rathbun.

Since that date the following species and subspecies have been described.—

*I. formosensis* Rathbun, Proc. Biol. Soc. Wash., XXXIV, 1921, p. 156. (Formosa).

*I. delsmanni* de Man, Zool. Meded. Leiden, IX, 1926, p. 16. (Bay of Batavia).

*I. delsmanni yuhana* Rathbun, Lingnan Science Journal, VIII, 1929, p. 98. (Fukien).

*I. serrata* Shen, Bull. Fan Mem. Inst. Biol., II, 1931, p. 177. (Fukien).

*I. pingi* Shen, Zoologica Sinica, IX, 1932, p. 246. (Shantung and Liautung Peninsulas and Peichihli Bay).

*I. dentimerosa* Shen, t.c., p. 250. (Shantung Peninsula).

*I. dentata* Ward, Australian Zoologist, VII, 1933, p. 391. (Port Curtis, Queensland).

In my opinion *I. serrata* Shen is probably identical with *I. delsmanni yuhana* Rathbun.

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1. Stimpson, Proc. Acad. Nat. Sci. Phil., X, 1858, p. 98 [44].

2. de Man, Journ. Linn. Soc., Zool., XXII, 1888, p. 137.

3. Rathbun, Proc. Biol. Soc. Wash., XI, 1897, p. 164.

4. Rathbun, Proc. Biol. Soc. Wash., XXXIV, 1921, p. 156.

5. Kemp, Rec. Ind. Mus., XVI, 1919, p. 336.

In the present paper two new species from Singapore are described and the other five species and subspecies in the collection of the Raffles Museum are commented on. The types of the new species will be deposited in the British Museum.

In his description of *Scopimera intermedia*<sup>1</sup> Balss points out that the female abdomen of this species is broadened and completely covers the sternum, "ähnelt so also dem der Gattung *Ilyoplax*." Actually in the species of *Ilyoplax* in the present collection only two, *I. orientalis* (de Man) and *I. gangeticus* (Kemp), have the female abdomen broadened to this extent. In the other four species and the single subspecies the abdomen does not completely embrace the sternal segments.

For purposes of comparison figures are given of both male and female abdomina of all the species in the present collection.

***Ilyoplax delsmanni* de Man.** Plate III; *a*, *b*.

1926. *Ilyoplax delsmanni* de Man, Zool. Meded. Leiden, IX, p. 16. (Bay of Batavia).

**Material.**—A number of specimens from Port Swettenham on the west coast of the Malay Peninsula.

Most of the specimens were collected in and around the mouths of burrows apparently much too large to have been excavated by themselves; sometimes as many as eight or ten would be present in one burrow. No other animal was found in these burrows, and I cannot be sure whether they were abandoned or inhabited by an animal that burrows very deeply.

de Man, on the authority of Dr. Delsman, describes them as occurring amidst the colonies of *Gelasimus*. Several species of *Gelasimus* (*Uca*) were present on the mud-flats at Port Swettenham, but they were mostly living higher above low water mark than the *Ilyoplax*.

***Ilyoplax delsmnii yuhana* Rathbun.**<sup>2</sup>

1929. *Ilyoplax delsmnii yuhana* Rathbun, Lingnan Science Journal, VIII, p. 98. (Fukien).

1931. ? *Ilyoplax serrata* Shen, Bull. Fan. Mem. Inst. Biol., II, p. 177.

In his description of *I. serrata* Shen gives no comparison of his species with *I. delsmnii yuhana* Rathbun. The two descriptions, however, obviously refer to closely related, if not identical, forms, and as part of Dr. Rathbun's material came from near the type locality of *I. serrata* (Amoy), it seems probable that *I. serrata* should be reduced to the synonymy of *yuhana*.

Comparison of this form with *I. delsmanni* de Man from the west coast of the Malay Peninsula leads me to agree with Dr. Rathbun in regarding *yuhana* as a subspecies of *I. delsmanni*.

<sup>1</sup>. Balss, Zool. Anzeiger, CVI, 1934, p. 233.

<sup>2</sup>. Dr. Rathbun has kindly conformed the identification of these specimens.

*Material*.—A number of specimens from mud-flats at Kuala Sedili, Johore, on the east coast of the Malay Peninsula, Nov., 1934. Their environment and habits are exactly as described for *I. delsmanni*.

***Ilyoplax orientalis*** (de Man). Plate III; c, d.

1888. *Dioxiippe orientalis* de Man, Journ. Linn. Soc., Zool., XXII, p. 138. (Mergui Archipelago).

1919. *Tympanomerus orientalis*, Kemp, Rec. Ind. Mus., XVI, p. 347.

*Material*.—Numerous specimens from Singapore (Serangoon River, Jurong River); the Johore Strait; Kuala Sedili, east coast of Johore; Port Swettenham.

This species is found abundantly burrowing in soft mud between tide marks, particularly at the mouths of rivers.

***Ilyoplax gangetica*** (Kemp). Plate III; e, f.

1919. *Tympanomerus gangeticus* Kemp, Rec. Ind. Mus., XVI, p. 347. (Gangetic Delta).

This species was described by Kemp from two specimens from the Gangetic delta, a comparison being made with the closely allied *I. orientalis* (de Man). The present series enables me to supplement the original description in a few minor points.

The carapace of *I. gangetica* is distinctly longer in relation to its breadth than that of de Man's species, the ratio of breadth to length being 0.8 as against about 0.74 in *I. orientalis*.

In the male abdomen, as Kemp points out, the constriction at the fifth segment is less marked in the present species, and also the sides of the penultimate segment are regularly convex, whereas in *I. orientalis* they are sinuous and bluntly angled at their distal extremities.

The chelipeds are described as a little shorter than in *I. orientalis*. This is a character which in both species varies with the size of the specimen. In the largest male of *I. gangetica* in the present series, measuring 5.6 mm. in anterior carapace breadth, the chelipeds are much elongated, the carpus and chela measuring 4.0 and 6.5 mm. respectively.

*Material*.—Fifteen males and an equal number of females from Port Swettenham, Dec., 1934, found burrowing in soft mud between tide marks, associated with *I. orientalis* and *I. delsmanni*.

***Ilyoplax lingulata*** (Rathbun). Plate III, g, h.

1909. *Cleistostoma lingulatum* Rathbun, Proc. Biol. Soc. Wash., XXII, p. 108. (Lem Ngob, Gulf of Siam).

1910. *Cleistostoma lingulatum*, Rathbun, K. Danske Vidensk. Selsk. Skrift. (7), Afd. V, p. 323.

1919. *Tympanomerus lingulatus*, Kemp, Rec. Ind. Mus., XVI, p. 344.

An interesting feature of this species, which appears to have escaped notice until now, is the presence on the infra-orbital ridge of the male of a row of brown papillæ, directed inwards and decreasing in size laterally. They occupy the same position as the teeth on the infra-orbital ridge of, for example, *I. delsmanni*, de Man, but are quite different in character, being soft and slightly flexible when touched with a needle, and somewhat translucent. In the female they are replaced by a row of sharp, setiferous granules, which are clearly indicated in Rathbun's figure 8 (l.c.).

It is difficult to be sure of their function, but possibly they form part of a stridulating organ used in conjunction with the compressed spine on the carpus of the cheliped, with which they may be brought into contact by an inward movement of the cheliped.

*Material*.—A good series of specimens from Singapore (Jurong River and the Johore Strait).

All the specimens were taken in mangrove swamps, crawling about the roots of the trees. They do not appear to inhabit burrows.

*Ilyoplax punctata* sp. n. Plate II; 1, 1 *a*. Plate III; *i*, *j*.

*Cotypes*.—Adult male and female collected by the writer in mangrove swamp near the river Jurong, Singapore, April, 1934.

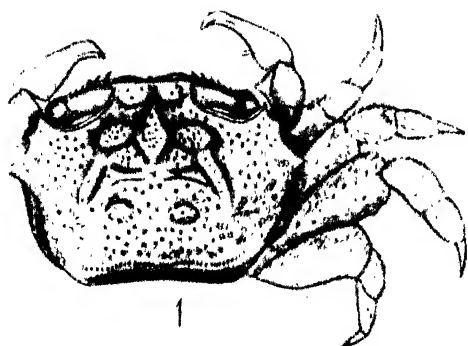
This species is found commonly in mangrove swamps. It is usually associated with *I. lingulata* (Rathbun) and has the same habits.

*Material*.—Numerous specimens from Singapore (Jurong River); the Johore Strait; Kuala Sedili, east coast Johore; Port Swettenham.

*Characters*.—This species has its nearest ally in *I. lingulata* (Rathbun) from which it is immediately distinguished by the coarsely punctate condition and the absence of hair on the carapace, by the absence of the distinctive oval depressions which are present on the front of *I. lingulata*, and by the unarmed fingers of the chelæ.

*Description*.—The carapace is convex fore and aft, the front being strongly deflexed. From side to side, at the level of the epibranchial teeth, it is nearly flat, but behind this the branchial regions are steeply declivous laterally.

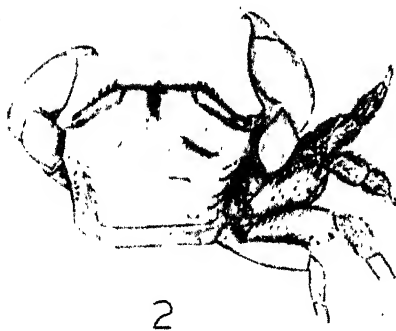
The surface of the carapace is everywhere coarsely punctate, the punctæ being larger on the branchial regions than elsewhere. On the gastric region there are seven low prominences. The



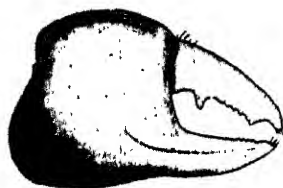
1



1a



2



2a





anterior two are situated just behind the front, between the orbits; next, a row of three across the protogastric and mesogastric regions, and finally another pair on the metagastric region. Just behind these two there is, in the adult male, a depressed transverse line, curved back towards its lateral extremities and briefly interrupted in the middle. In females and small males this feature is obscure. On the cardiac region there is a pair of prominences about as large as those on the protogastric areas. As is usual in the genus, there is a raised line running close and parallel to the posterior border. The branchial regions are beset with granules, singly and in clusters; posteriorly the granules are arranged in oblique, irregular lines, the hindmost one of which is sharply angled, its inner half coinciding with the outer extremity of the line parallel to the posterior border. There is, in addition, a longitudinal granular line on the steeply declivous part of the branchial regions.

The anterolateral borders are short, the external orbital angle is dentiform and directed obliquely outwards; just behind it is another smaller tooth, and behind this, separated by a rather larger gap, is the epibranchial tooth, which is blunt but salient and directed outwards.

The posterolateral borders are beaded in all their extent.

The frontal border is transverse and nearly straight, its median quarter being a little in advance of the lateral portions, and very slightly emarginate. Laterally it meets the upper orbital margins in a right angle.

The eyes are short and thick, and the orbits slightly oblique. The upper orbital margin is sinuous, thickened and finely beaded; in the middle, opposite the thinnest part of the eye stalk, it is double and encloses a small, smooth space. Here the thickening and beading follows the posterior of the two margins. The lower orbital margin is also finely beaded, and separated from the external orbital angle by a gap; in its inner two thirds it is beset with hairs. Below it there is a minutely denticulate line starting at a point near the basal antennal joint and running obliquely outwards and upwards to join the suborbital border at a point two thirds of its length from its inner end. Below this is the suborbital ridge, the armature of which differs in the two sexes in the same way as described in *I. lingulata*. In the male there are usually seven brown papillæ, developed much as in *I. lingulata*, but larger and more conspicuous. Here against they decrease in size from within outwards, and external to the outer one the suborbital ridge is marked by fine setiferous granules, and curves sharply to a point just below the outer orbital angle.

As in *I. lingulata* the antennules are minute and almost concealed beneath the front and the inter-antennular septum is wide. The median tooth of the epistome is broader and shorter than in the allied species.

The buccal cavern is relatively smaller and much broader than in *I. lingulata*. The merus of the external maxillipeds is triangular in shape and has a sulcus parallel to its outer margin; its surface is finely punctate. The ischium is much broader than long, and its outer margin meets that of the merus at a marked angle. As in *I. lingulata* it carries an oblique hairy ridge.

The abdomen of the male is similar in shape to that of *I. lingulata*, but is less broadened towards the base and its terminal segment is a little narrower. In both species the female abdomen, though much broader than that of the male, does not completely cover the sternal segments. The abdomen and sternum of *I. punctata* are punctate in both sexes.

The male chelæ are relatively small and weak. The merus is short and trigonal with the inner margin rounded and the lower one armed with a few spinules. The carpus is about as broad as long and is armed on its inner aspect with a compressed spine. The palm is as high as it is long and its surface is smooth except for scattered punctæ. It bears an obscure and minutely serrulate crest on its upper margin, and a punctate and setose line runs from it on to the immobile finger. Its surface is ornamented with dark, reticulating lines. The fingers bear no large teeth on their inner edges but are obscurely denticulate a little way behind the tips. The tips are brown in colour, spoon-shaped and setose. The dactylus is setose along its upper margin. When closed the fingers only meet at the tips, leaving a wide gap between the bases.

The ambulatory legs are thick and strong. The meri are granular above and somewhat tomentose, below they are coarsely punctate. The carpi and propodi are tomentose above and punctate below.

*Measurements of male cotype.*—

Greatest breadth of carapace	..	6.9 mm.
Length of carapace	..	4.5 "
Breadth of front	..	2.0 "
Antero-lateral border	..	1.3 "
Postero-lateral border	..	3.0 "
Posterior border	..	3.6 "
Merus of cheliped	..	2.0 "
Carpus of cheliped	..	1.5 "
Chela	..	2.8 "

*Ilyoplax obliqua* sp. n. Plate II; 2, 2a. Plate III; k, l.

*Cotypes*.—Adult male and female collected by the writer in mangrove swamp near the river Jurong, Singapore, August, 1934.

This species is found associated with *I. lingulata* (Rathbun) and *I. punctata* Tweedie in mangrove swamps, but is less common than either.

*Material*.—Thirty specimens from Singapore (Jurong River and Serangoon) and two from Port Swettenham.

*Characters*.—This species is related to *I. punctata* and to *I. lingulata*, the male having the characteristic papillæ on the infra-orbital ridge. It is immediately distinguishable from either by the smooth and hairless carapace and the very obliquely directed orbits.

*Description*.—The carapace is only slightly convex in both directions, and the posterior branchial regions are deflected less steeply than in *I. punctata*, forming a triangular facet. The surface of the carapace is smooth and very finely and sparsely punctate. A broad and rather deep longitudinal sulcus occupies the median part of the front, and a pair of shallow, transverse sulci run from near the epibranchial angles on to the lateral portions of the gastric region. The usual raised line is present, parallel to the posterior border.

On the posterior branchial regions are a series of beaded lines. The most anterior one is very short and runs inwards from the epibranchial angle. Behind it is a series of four or five rather longer curved lines arranged *en échelon*, one behind the other, the last one sharply curved and joining the outer ends of the line parallel to the posterior border. Another series of granules or granular lines runs from a point near the epibranchial angle backwards across the posterior branchial facet. This ornamentation on the otherwise smooth carapace is always distinctly developed and appears to be highly characteristic of the species.

The external orbital angles are sharp and rectangular, and the antero-lateral borders are short and entire and usually straight, but may be a little sinuous. They meet the postero-lateral borders at a very slight angle, so that the lateral epibranchial angles are very obtuse, somewhat as in certain species of *Uca*, for example *U. dussumieri* (M.E.).

The surface of the front is sulcate in the middle line, as mentioned above, and its free edge is almost straight.

The orbits are very oblique. Their upper margins are smooth, somewhat sinuous, and double for a short distance about the middle of their length, just as described for *I. punctata*.

The lower orbital margin is sinuous and beaded; it carries a few long hairs at a point just opposite the cornea of the eye. Below it, as in *I. punctata*, there is a denticulate line starting near the basal antennal joint, but it runs more nearly parallel to the infra-orbital margin, and does not actually meet it.

Below this in the male the suborbital ridge carries a series of seven to eight inwardly directed, conical papillæ, graded as in *I. punctata*. Here, however, they are even larger and more conspicuous. In the female the suborbital ridge is sharply denticulate and in both sexes its external continuation is setiferous and curves upwards towards the outer orbital angle.

The median tooth of the epistome is triangular rather than lingulate, and is strongly inclined forwards, so that it is distinctly visible in dorsal view.

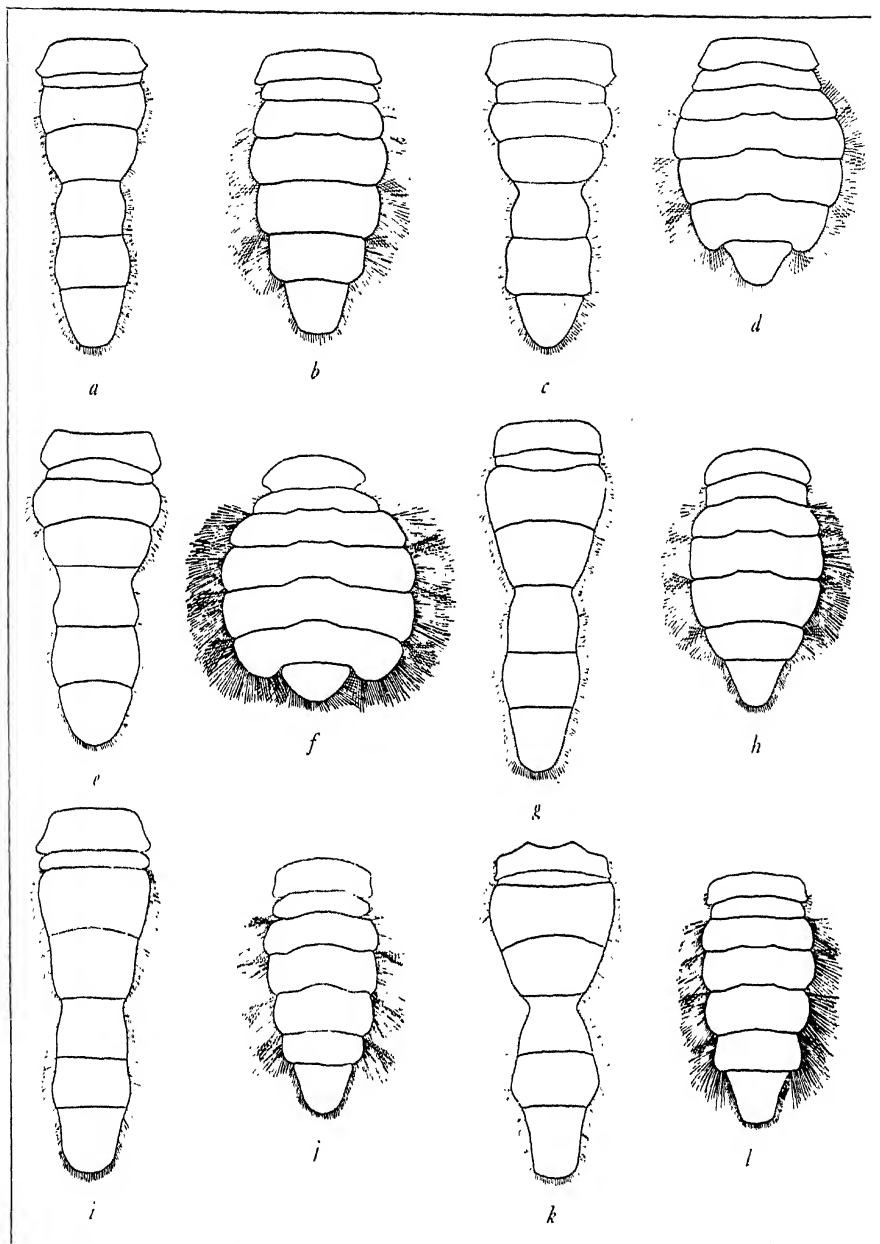
The shape of the buccal cavern and the proportions and sculpturing of the articles of the external maxillipeds is almost exactly as in *I. lingulata*, the meri being oval in shape and the ischia only slightly broader than long.

The abdomen of the male has a highly characteristic shape, being much broadened at the base and at the sixth segment, the sides of which are bluntly angular. The constriction at the fifth segment is far more pronounced than in the two allied species. Here again the female abdomen is not broadened so as to cover the sternal segments.

In the male chela the merus is trigonal. The lower margin is conspicuously denticulate and the inner one granular in its basal half. The outer surface bears some scattered granules. The carpus is short and bears a compressed spine on its inner aspect.

The palm of the chela is about as high as it is long and has a minutely crenulated crest on its upper margin. It is smooth except for a few scattered punctæ and a punctate line running on to the immobile finger. The cutting edge of the dactylus is armed with a strong tooth near the base and another, lower one, near the tip; between the two teeth it is denticulate. The immobile finger has no enlarged teeth, but is denticulate a little behind the tip. The finger tips are setose and slightly expanded.

In the ambulatory legs the meri are broad, but show no trace of "tympana." Their anterior margins are finely granular, and the upper surfaces of those of the three anterior pairs carry scattered spinules. The carpi and propodi and the distal parts of the meri are tomentose.



*Ilyoplax* spp.



# REPTILES AND AMPHIBIANS FROM PERAK, MALAY PENINSULA

## Measurements of male cotype.—

Greatest breadth of carapace	..	5 mm.
Length of carapace	..	3.7 "
Breadth of front	..	1.6 "
Antero-lateral border	..	0.8 "
Postero-lateral border	..	2.0 "
Posterior border	..	2.7 "
Merus of cheliped	..	2.0 "
Carpus of cheliped	..	1.5 "
Chela	..	3.2 "

## EXPLANATION OF PLATE II

- Ilyoplax punctata* sp. n. Fig. 1, adult male.  
Fig. 1a, male chela.  
*Ilyoplax obliqua* sp. n. Fig. 2, adult male.  
Fig. 2a, male chela.

## EXPLANATION OF PLATE III

Male and female abdomina of *Ilyoplax* spp. a, *I. delsmanni* de Man, ♂; b, ♀. c, *I. orientalis* (de Man), ♂; d, ♀. e, *I. gangetica* (Kemp), ♂; f, ♀. g, *I. lingulata* (Rathbun), ♂; h, ♀. i, *I. punctata* sp. n., ♂; j, ♀. k, *I. obliqua* sp. n., ♂; l, ♀.

## On a Collection of Reptiles and Amphibians from Perak, Malay Peninsula

By MALCOLM A. SMITH

(Plate IV)

The herpetological fauna of the Malay Peninsula is now pretty completely known, but that novelties can still be obtained there is shewn by a small collection of reptiles and amphibians made by Mr. M. W. F. TWEEDIE in Eastern Perak during March, 1933. The area visited by him lies on the borders of Kelantan, a densely forested mountainous district at the headwaters of the Plus River. It is one of the few places in the Peninsula not previously visited by a collector of reptiles.

The following species were obtained; all were found below 3,000 feet altitude.



**Lizards.**

*Gymnodactylus marmoratus*, *Goniocephalus belli*, *Aphanio-  
tis fusca*, *Mabuya multifasciata*, *M. rugifera*, and a single  
specimen of the rare *Lygosoma butleri*.

As I have shewn elsewhere (Fauna Brit. India, II, Lizards,  
*Goniocephalus belli* Dum. and Bib., 1837 is synonymous with  
*G. borneensis* Schlegel 1848.

**Snakes.**

*Lycodon subcinctus*, *Passerita prasina*, *Trimeresurus  
gramineus*.

**Amphibians.**

A large series of *Ichthyophis glutinosus* and *I. monochrous*,  
mostly late larval forms; *Megophrys nasuta* and *M. hasseltii* and  
a series of tadpoles of each; *Bufo asper* and some tadpoles of that  
toad shewing well the peculiar character of the lower lip; *B.  
parvus*; two examples of *Phrynoglossus laevis*, a rare frog in  
the Malay Peninsula; *Rana laticeps*; a single tadpole which I  
assign to *Rana larutensis*; and a new frog which I have pleasure  
in naming after its discoverer.

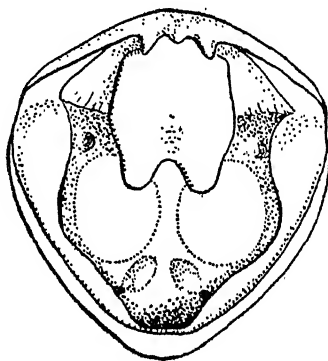
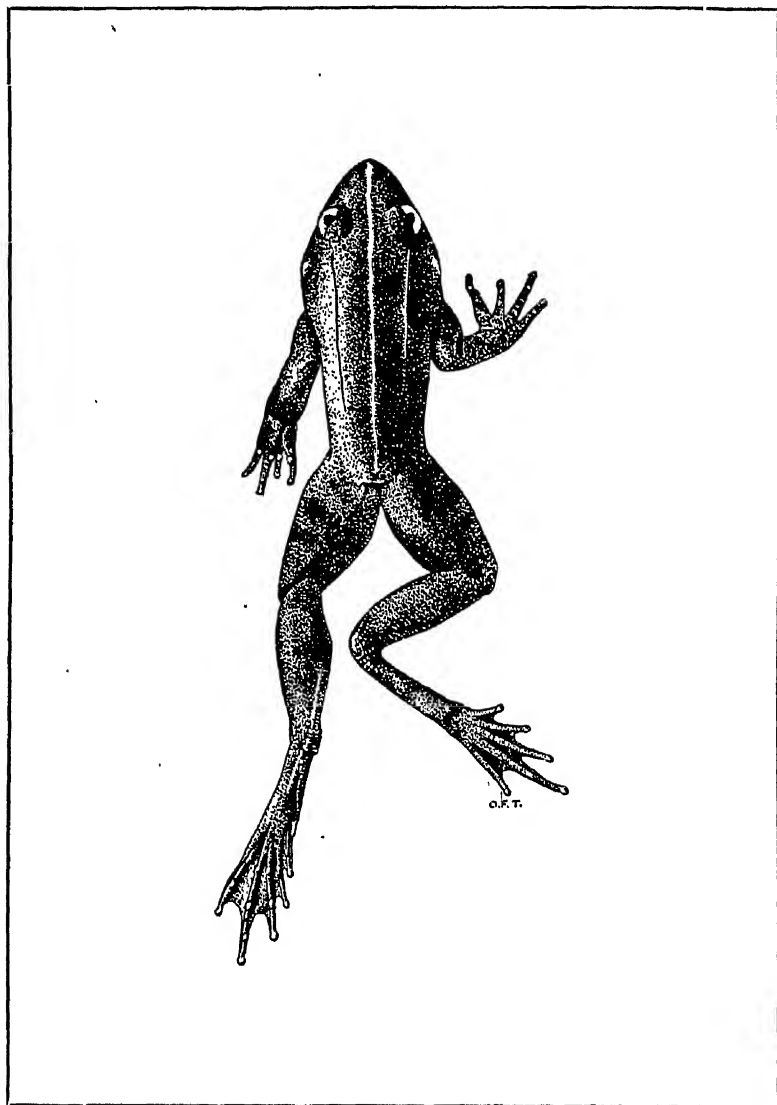


Fig. 1. *Rana tweediei* n. sp. Buccal cavity.

*Rana tweediei*, sp. nov. PLATE IV

Description of the type. Male, apparently fully grown,  
Brit. Mus. 1934. 5. 21. I. Type locality near the River Yum,  
Headwaters Plus River, alt. 2,000 feet.

Vomerine teeth well developed, in oblique groups commen-  
cing on a level with the choanæ and extending well behind them,  
about as far distant from the choanæ as from each other. Lower  
jaw with two well-developed tooth-like projections in front.  
Head not enlarged, moderately depressed, about as long as broad;



*Rana tweediei* n.sp.



snout obtusely pointed, projecting slightly beyond the lower jaw; canthus rostralis feebly distinct; loreal region oblique, scarcely concave; nostril equidistant from the eye and the tip of the snout; distance between the nostrils a little greater than the interorbital width which is distinctly greater than the width of the upper eyelid; tympanum scarcely distinct, its diameter about half that of the eye.

Fingers swollen at the tips, but without horizontal groove between the upper and lower surfaces; first finger longer than second; subarticular tubercles large, prominent. Hind limb moderately long, the tibio-tarsal articulation reaching as far as the front of the eye; heels strongly overlapping when the limbs are folded at right angles to the body; tibia a little more than half the length of the head and body, longer than the foot; discs of toes a little larger than those of the fingers, also without horizontal groove; third toe much longer than fifth; toes three-quarters webbed, the membrane extending to the discs of the third and fifth toes, but deeply emarginate; two phalanges of the fourth toe free, but the web extending as a fringe to the disc; a fringe along the outer side of the fifth toe; a tarsal fold; inner metatarsal tubercle elongate, more than half the length of the first toe, no outer tubercle; outer metatarsals separated for half their length.

Skin of the upper parts almost quite smooth; a fine but quite distinct dorso-lateral fold starting from behind the upper eyelid and extending nearly to the level of the groin; supratympanic fold feebly distinct; some tubercles on the upper eyelid.

Purplish-brown in life above with a fine yellow vertebral stripe, and with a fine, more or less distinct, light line down the middle of each leg behind; whitish below, the throat spotted with dark brown; limbs with dark cross bars. No secondary sex characters.

From snout to vent, 37 mm.

Five juveniles, the largest measuring 22 mm. from snout to vent, do not differ much from the type. The dorso-lateral fold may be more distinct, and some have irregular glandules on the sides of the body; the tibio-tarsal articulation may reach as far as the nostril; a light bar may be present between the eyes, but none of them has the vertebral stripe or the light line down the hind limb.

*Rana tweediei* is most nearly related to *R. laticeps* which was also obtained in the same locality. It differs in having a fine glandular dorso-lateral fold and smoother skin, a narrower head and more pointed snout, a shorter hind limb and more extensive web to the toes, as well as in coloration. As with *laticeps* and its near ally *kuhli*, both the eyes and the nostrils in *R. tweediei* are placed well upon the upper surface of the head.

## A New Species of Amphipod from Mt. Kinabalu, North Borneo

By CLARENCE R. SHOEMAKER

United States National Museum, Washington, D.C., U.S.A.

(Plate V)

In July, 1934 I received from the Raffles Museum and Library, Singapore, Straits Settlements, through the courtesy of its director, Mr. F. N. Chasen, a small collection of amphipods taken by him and H. M. Pendlebury on Mt. Kinabalu, British North Borneo at elevations of 6,000 to 10,000 feet. The specimens, about 30 in number, unfortunately all females, belong to the *Talitridae*, and upon examination were found to be representatives of the genus *Parorchestia*, which has not heretofore been recorded from Borneo, the nearest record coming from the island of Luzon, Philippine Islands. There is no information on the labels accompanying the specimens as to the nature of the habitat from which they came, but judging from the very much reduced and weakened condition of the pleopods they are undoubtedly terrestrial.<sup>1</sup>

The descriptions of some of the species of *Parorchestia* are rather inadequate and many are insufficiently figured, nevertheless from the combination of characters possessed by the present specimens I believe them to represent a new species which I here designate as *Parorchestia kinabaluensis*.

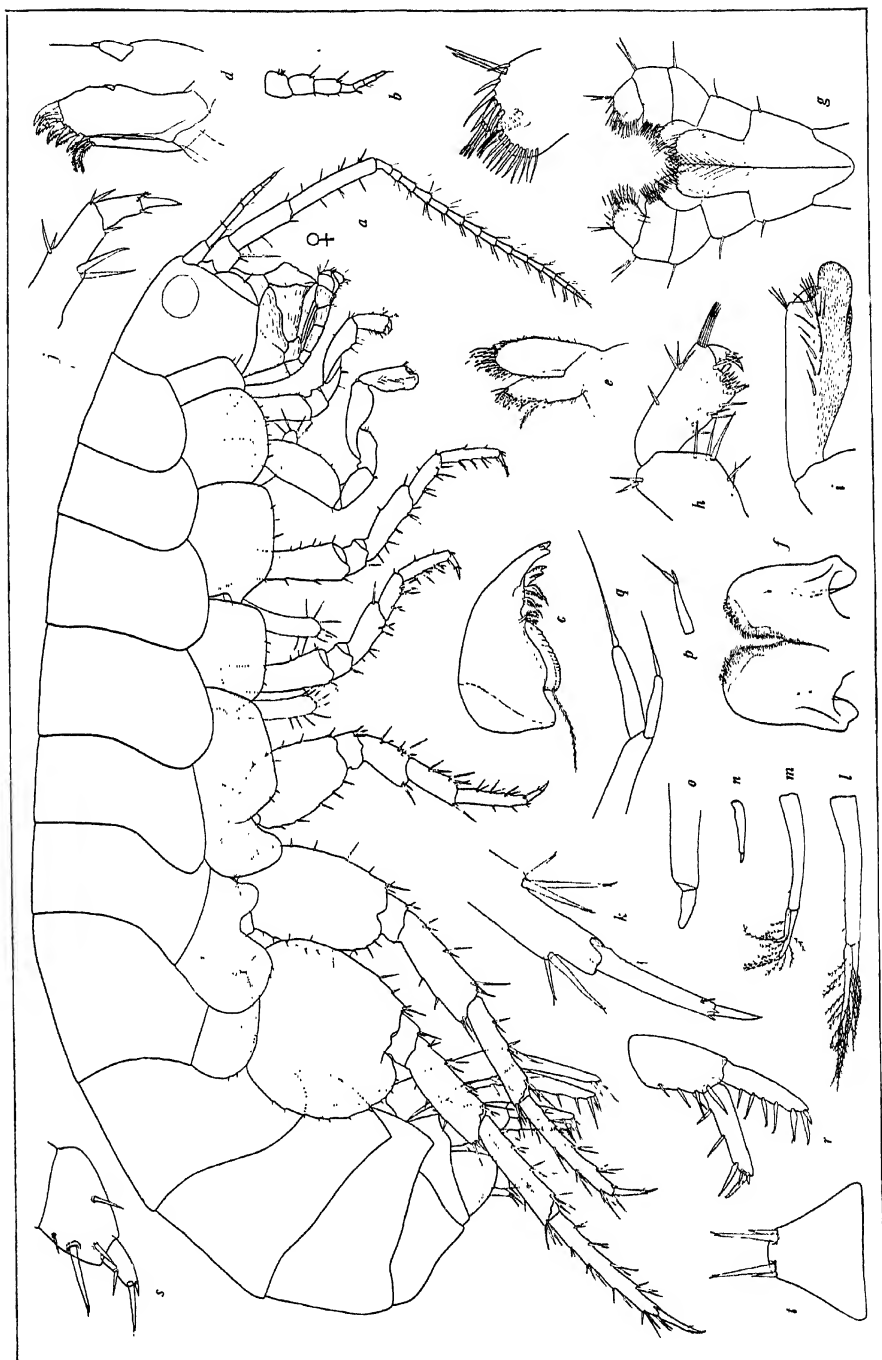
The specimens were collected in 1929 on Mt. Kinabalu at Pakka, 10,000 feet; Marei Parei, 6,000 feet; and Kamborangah, 7,200 feet. The altitude of 10,000 feet is the highest yet recorded for this genus.

***Parorchestia kinabaluensis***, new species. Plate V.

*Description of female*.—Eye of medium size, nearly round, black. Antenna 1 projecting very slightly beyond the fourth peduncular joint of antenna 2, peduncular joints subequal in length and dorso-ventrally flattened, flagellum of five joints, the last being very small. Antenna 2 slender, fifth peduncular joint longer than fourth, third bearing at the lower distal corner a long conspicuous spine and one or two shorter ones, flagellum longer than peduncle and composed of about 14 joints. Mandible with well-developed accessory plate, four spines in spine-row, a short, stout plumose seta at front end of molar and a long slender plumose seta at the back edge of molar. Maxilla 1, the long slender inner plate bearing two plumose setæ, the outer

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1. These small and very active, reddish amphipods were found under stones and among fallen leaves: this mountain-shrimp can jump as elusively as its seashore relatives. F.N.C.



*Parorchestia kinabaluensis* n.sp.



plate with nine serrate spine-teeth, palp very small with second joint minute. Maxilla 2, inner plate with long curved plumose seta about the middle of inner edge. Maxillipeds, inner plate reaching to the middle of outer plate, armed with three stout spine-teeth and many plumose setæ, outer plate short, reaching to about the middle of second joint of palp and armed on inner edge with a closely set row of submarginal slender spines, palp short and robust, fourth joint small but distinct and bearing three distal spines. Lower lip without inner lobes, outer lobes long and distally rounding, mandibular processes short and blunt. Gnathopod 1, second joint a little longer than fifth, sixth a little over half as long as fifth, widening distally, palm nearly transverse with a row of submarginal spines on either side. Gnathopod 2, second joint slightly expanded, sixth joint shorter than fifth. Peræopods 1 and 2 alike except that 1 is a little the longer. Peræopod 3 about as long as 1 and much shorter than 4 which is shorter than 5. Second joint of peræopods 3 and 4 moderately expanded, that of 5 greatly expanded. Branchial vesicles much twisted and lobed. Side-plate 1 much narrower than 2. Side-plates 2 to 4 with a posterior point above which hind margin is excavate. Side-plate 5 with front lobe much wider than hind lobe. Pleon segment 1 with postero-lateral angle broadly rounding. Pleon segments 2 and 3 with this angle very slightly produced, and their postero-lateral margins smooth. Pleopods reduced and weak, second shorter than first and third less than half the length of second. The rami of the first and second pleopods are much reduced and bear only a few short plumose setæ. In many specimens the third pleopod is reduced to a very short peduncle with a single vestigial ramus, while in others the short peduncle bears two greatly reduced rami each with a single long terminal seta. Uropod 1 without marginal spines on outer ramus. Uropod 2 with about five spines on outer ramus. Uropod 3 with a prominent spine on upper margin of peduncle. In some specimens there are other spines upon this peduncle as shown in plate V, s; ramus rather slender and much shorter than peduncle, armed with a long and a short apical spine, and in some specimens one about the middle of the upper margin. Telson with the slightly concave sides converging to the rather narrow convex hind margin, which bears at either corner one long and one short spine.

*Length.*—11 mm.

Type taken at Marei Parei, Mt. Kinabalu, British North Borneo at an altitude of 6,000 feet, May 1, 1929. Type in the collection of the United States National Museum, Washington, D. C., Cat. No. 70784.

The fifth side-plate in *Parorchestia kinabaluensis* is much like that of *Talitriator eastwoodae*, *T. sylvaticus* (Haswell), and



*T. kershawi* (Sayce), but it is excluded from the genus *Talitriator* by the possession of strongly subchelate first gnathopods.

The following twelve species of *Parorchestia* have been heretofore described:

- Parorchestia tenuis* (Dana) 1852. Recorded from New Zealand, among roots of grass and in a small stream; Campbell Island, at the mouth of a small stream; Sunday Island, from a fresh-water stream; Salt River near Cape Town, South Africa, in brackish pool; East London, South Africa, on beach with *Talorchestia*; Dyer Islands, South Africa; Manukau, Chatham Islands, wet cliffs. "Like so many other *Orchestidae*, it may be also more or less terrestrial in habit."—Chilton.
- Parorchestia sylvicola* (Dana) 1852. Recorded from New Zealand, from moist soil in the bottom of the extinct volcano of Taiaimai far from the sea; Sunday Island, Kermadec Islands, under dead leaves; Wharkauri, among bush on hillside, and Plateau Bush, Owenga, Chatham Islands; Lord Howe Island (terrestrial).
- Parorchestia hawaiiensis* (Dana) 1853 and 55. Hawaiian Islands (terrestrial?).
- Parorchestia maynei* Chilton 1909. Norman's Inlet, Auckland Island; Disappointment Island; Adams Island (2,000 ft. alt.).
- Parorchestia insularis* Chilton 1909. Campbell Island (terrestrial, up to the tops of the highest hills).
- Parorchestia parva* Chilton 1909. Norman's Inlet, Auckland Island and also under logs on Auckland Island (terrestrial).
- Parorchestia improvisa* Chilton 1909. The Snares; Stewart Islands and New Zealand (terrestrial).
- Parorchestia luzonensis* Baker 1915. Laguna Province, Luzon, Philippine Islands, summit of Mount Maquiling, in the extinct crater, under stones (terrestrial).
- Parorchestia lagunae* Baker 1915. Laguna Province, Luzon, Philippine Islands, shores of Bay Lake, under stones at water margin (terrestrial).
- Parorchestia sarasini* Chevreux 1915. From forest on Mt. Ignambi, New Caledonia, 800-1000 meters (terrestrial).
- Parorchestia pusilla* Chevreux 1915. "Lac en 8, sur les ajoncs, près de la rive," New Caledonia.—Chevreux.
- Parorchestia dassenensis* Barnard 1916. Dassen Island and Hout Bay, west coast, Union of South Africa.

EXPLANATION OF PLATE V

*Parorchestia kinabaluensis*, nov. sp. female. *a*, entire animal. *b*, antenna 1, top view. *c*, mandible. *d*, maxilla 1. *e*, maxilla 2. *f*, lower lip. *g*, maxillipeds, *h*, end of gnathopod 1. *i*, end of gnathopod 2. *j*, end of peraeopod 2. *k*, end of peraeopod 5. *l*, pleopod 1. *m*, pleopod 2. *n*, pleopod 3. *o*, end of pleopod 3 greatly enlarged. *p*, pleopod 3 of another specimen. *q*, end of same, greatly enlarged. *r*, uropod 2. *s*, uropod 3. *t*, telson.

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## Leeches from Borneo and the Malay Peninsula

By J. PERCY MOORE

(Plates VI, VII)

This paper deals with several small lots of land and freshwater leeches mostly submitted by Mr. F. N. Chasen, Director, and Mr. M. W. F. Tweedie, Curator, of the Raffles Museum, as follows: 12 vials from Mt. Kinabalu, North Borneo, collected by F. N. Chasen and H. M. Pendlebury in 1929; 2 vials from the lowlands near Kuching, 1932; 1 vial from Upper Perak, Federated Malay States, collected by A. G. Billing in 1932; 6 lots from Sarawak, collected by E. Banks in 1933; 1 vial from Trengganu, north Malay Peninsula, collected by Dr. R. Braine; and two lots from the valley of the river Plus in Upper Perak collected by Mr. Tweedie in 1933. In addition are several lots collected by Dr. H. M. Smith and Dr. A. S. Pearse in Siam and one vial collected in Cochin-China by E. Poilane, and sent to me by Dr. W. L. Schmitt of the U. S. National Museum.

These collections are all incomplete and contain representatives of two families only, the jawed blood-sucking Hirudidæ and the predacious burrowing Erpobdellidæ.

Although including only three species the leeches from Perak are of especial interest as being the first that have been reported from that area. As might be expected they show faunal affinities with both China and Malaysia. There is a second species of *Gastrostomobdella*, differing sharply from the Bornean type species, numerous examples of a new subspecies of *Haemadipsa sylvestris*, first discovered in Siam and known from Cochin-China also, and several specimens of *Myxobdella annandalei*, previously known from China and India. Those from Mt. Kinabalu were taken at elevations from 3,300 to 10,000 feet and include three forms of true land leeches: *Haemadipsa picta*, *H. zeylanica*

*sumatrana*, and *H. z. subagilis*; and two species of burrowing predacious Erpobdellidæ: *Gastrostomobdella monticola* and *Mimobdella büttikoferi*. The first four were found by Dr. Mjoberg at similar elevations on Mt. Poi and other peaks but the latter was unrepresented in his collection.

Details concerning the collecting stations on Mt. Kinabalu will be found in Smith and Chasen, Herpetology of Mt. Kinabalu, 1931.

Through the kindness of the Director of the Raffles Museum I am permitted to keep the type of *G. vagabunda* which with that of *M. s. interrupta* will be deposited in the Academy of Natural Sciences of Philadelphia. Sections used in this study were prepared by Miss Margaret Long under a grant from the Special Research Fund of the University of Pennsylvania.

#### GLOSSIPHONIDÆ

##### *Paraclepsis vulnifera* Harding 1924.

A single small specimen is the sole representative in these collections not only of the family but of the suborder Rhynchobdellæ. It was collected by Dr. A. S. Pearse from the branchial chamber of a ♀ fresh-water crab (*Paratelphusa sinensis* M.-Edw.) at Bangkok, Siam, on Dec. 27, 1929. It is less than one-half the size of Harding's specimens, measuring  $8 \times 2.5$  mm. which explains the inconspicuousness of the numerous small papillæ. The arrangement of the eyes, genital orifices and annulation, so far as worked out, agree with Harding's description. In life this leech is probably nearly colorless or pale red as there appears to be no definite pigmentation. In the preserved specimen the skin is translucent and there are faint light and dark longitudinal lines due to the longitudinal muscle bundles and brownish transverse bars due to the ingested blood in the gastric cæca. The only other record of this species is of the types, also from the branchial chamber of a *Paratelphusa* (sp. ?) taken in the Tanjore Dist., Madras Presidency. That this species is really distinct from *P. praedatrix* remains to be established by the study of more abundant material.

#### HIRUDIDÆ

##### *Myxobdella annandalei* Oka 1917.

This very interesting species was found by Mr. Tweedie in the hills of Perak associated with *Haemadipsa sylvestris interrupta* and *Gastrostomobdella vagabunda*. Three of the specimens are quite small, varying from  $15 \times 5 \times 2$  to  $18 \times 6.6 \times 3.5$  mm., and two are full grown, measuring  $68 \times 19 \times 8$  and the largest strongly contracted one  $55 \times 22.5 \times 8.5$  mm. (Pl. VI, fig. 5; Pl. VII, fig. 9.).

Several have the cuneate form which is so characteristic of most preserved examples of the species. In all the caudal sucker is very large and the annulation normal, presenting that noteworthy inequality of depth of the interannular furrows of the several orders which is indicative of their phylogenetic succession and one of the striking characteristics of the genus. Most of the specimens exhibit much less of that tumidity and oedema which were noted in earlier writings but they are present in some degree in all and markedly on some specimens. In all cases the peculiar velar papilla is evident projecting from the posterior buccal wall and perforated by the small, triangular mouth, through which the three small jaws may be seen. This papilla is the homologue of the tip of the proboscis of the *Rhynchobdellae*. While five pairs of eyes are invariably present only the first two or in some cases three are visible without special preparation, the fourth and fifth pairs being very small and deep-seated. The position of the genital orifices at XI *b5/b6* and XII *b5/b6* is constant. Nephropores are frequently visible on the caudal margin of *b2* of many somites.

The ground color as preserved is pale, gray or yellowish gray, more or less thickly blotched both dorsally and ventrally with black spots which may be rather large and confluent or contracted to give a finely speckled appearance.

Two localities are recorded: "Near River Yum, Plus Valley, Perak, Mar. 18, 1933;" and "Kuala Legap, Plus Valley, Perak, March, 1933." Previous records are from a mountain near Hong Kong, the Dawna Hills in Lower Burma and hills at Yercaud, Madras, all from streams. \* I found it under stones in a small spring-fed stream at 2,800 ft. at Mungpoo in the eastern Himalayan foothills of Darjeeling District. More recently Oka (1932) has greatly extended the range of this species by recording a specimen taken at Tiflis, Georgia.

### ***Hirudinaria manillensis* Lesson 1842.**

The synonymy and other aspects of this species are fully discussed in Moore, 1927, p. 218-226. It is an abundant species in the lowlands of the entire oriental region and the Raffles Museum collections include several lots from the vicinity of Kuching, Sarawak and from the Kinabatangan R., North Borneo. Also one from the U.S. National Museum, Bangkok, Siam, Oct. 20, 1932, H. M. SMITH.

### ***Hæmadipsa zeylanica sumatrana* (Horst) 1883.**

Although previous records (Moore '29) indicate that this is the common ground leech throughout Borneo except the western end, the collection includes but four examples, one from Kenokok, Mt. Kinabalu, Apr. 26, 1929 at 3,300 ft. in the

high forest, one (presumably near Tenompok) at 4,500 ft. on May 2, and two from Mt. Dulit, Sarawak, No. 5. There is also a doubtful specimen which approaches the next and which was taken along with a planarian of similar color pattern by H. M. Pendlebury on Mt. Kinabalu between Lumu Lumu and Kamborangah at about 6,000 ft., Mar. 19.

***Hæmadipsa zeylanica subagilis* Moore 1929.**

The only undoubted specimen of this subspecies was taken on Mt. Penrissen, Sarawak.

It is typical in every way.

The specimen from Lumu Lumu referred to under subspecies *sumatrana* resembles *subagilis* more closely in color, except that the median dark line is limited to the anterior half. On the other hand the head characters are more like the former. It differs from both in having partially developed dark brown supra- and submarginal stripes.

***Hæmadipsa* sp.<sup>1</sup>**

Several egg-cases (Pl. VII fig. 8) produced at Singapore, July 3, 1933, resemble those of other species of the genus seen by me. They are nearly globular, 8–9 mm. in outside diameter, with the inner capsule about half as large and enclosed in a single layer of about 35 irregularly polygonal compartments open externally and usually measuring about 2.5 mm. across at the periphery, with some smaller ones crowded among them. The material is translucent dusky-brown in color and of the consistency of rubber or soft cartilage. Two of them opened proved to be quite empty. Prof. W. A. Young of the Medical College at Singapore furnishes the following note which agrees with my own observations on capsule formation in Indian *Hæmadipsæ*. "They were laid on moist sand in a jar under leaves previously dried. The first sign of egg-laying is the deposition of what appears to be a froth-like material laid between a leaf and the sand. This appears to harden and form these peculiar egg capsules. The act of copulation has not been observed. Under a dissecting microscope the newly laid eggs were seen to contain a few unpigmented worm-like structures moving freely inside the capsule. None of the eggs came to maturity."

***Hæmadipsa sylvestris interrupta* subsp. nov.**

*Diagnosis.*—General aspect of *H. sylvestris* but smaller than the typical lowland form (the largest of over 80 specimens barely exceeding 1 in.) and differing in the following respects: Prehensile sucker papilla prominent and usually pointed and

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1. Probably *H. sylvestris interrupta*, M.W.F.T.

hooked; furrow pits best developed on somites IX and X, inconspicuous or absent on XII; median dorsal stripe broken into a series of distinct, quadrate metameric spots on *a2* and *b5* or confined to *a2*. (Pl. VI fig. 1-4).

Description of type from Koh Chang, Siam. Length in mm. 25, to  $\delta$  pore 7.5; widths, buccal 1.6, at  $\delta$  pore 2.2, maximum (XXIII) 3.4, anus 2.; depths at same levels, except anus, 1.5, 2, 2.5; sucker 3.4 $\times$ 4. Form robust and somewhat flattened posteriorly, tapering, slender and terete anteriorly. Lip with a shallow median ventral groove flanked on each side by 10-12 narrow ridges each bearing a series of minute sense papillae. On the dorsal face of the lip the marginal welt, bearing 3 or 4 rows of labial sense organs, is very distinct from the tessellated head annuli. Eyes very conspicuous, the five pairs as usual on annuli 2, 3, 4, 5 and 8. Median head areas present on somites III, IV and V and two small areas on each side between the 3rd and 4th eyes. Annuli V *a3* and VI *a1* complete. Somite VII 4-annulate and VIII 5-annulate. Furrow pits deep and in white spots on somites IX and X, smaller and less conspicuous on VIII and XI, absent on XII. Gonopores and nephropores as usual, the position of the latter indicated by minute black spots. On complete somites all annuli are divided into about 22-24 dorsal and as many ventral areas, each bearing a papillated rosette of 8 to 20 sense organs. At the caudal end somite XXIII is 4-annulate, XXIV 3-annulate, XXV-XXVII uniannulate. Auricles 3-lobed, the middle one smallest and triangular. Caudal sucker oval, sharply pointed with a prominent ventrally hooked papilla; rays 77. Color faded but generally like *sylvestris*; ground yellowish brown becoming reddish on venter, paler in mid-dorsal field. Dark brown pigment concentrated on margins of median dorsal field to form a pair of somewhat broken outer paramedian brown stripes which at one point in the caudal 1/3 nearly unite across the median field. Median stripe nearly black, broken into a series of metameric, sharply defined, quadrate or truncate spots on annuli *a2* and *b5* or confined to *a2*. Marginal pale and dark stripes practically obsolete. Sensillae and auricles colorless or nearly so.

The large number of individuals representing this subspecies are remarkably uniform. Very rarely the median dorsal stripe is continuous but in such examples it is alternately broad at *a2* and much constricted between. On very small specimens it is often faint. The most striking character is the prominence of the prehensile papilla on almost every specimen. The sucker rays vary from 74 to 83. Occasionally there is a complete transverse row of areas between the third and fourth eyes.

This leech is evidently abundant as most of the lots are large. It represents *H. sylvestris*, which is extensively distributed throughout Burma and eastern India, in a broad belt extending through the Malay Peninsula, Siam, and Cochinchina. Whether the *H. sylvestris* reported from Java and Sumatra by Blanchard belongs to this form is at present unknown.

Koh Chang, Siam, June 9, 1930, in forest, Dr. A. S. Pearse, 40, including type; Bienhoa, Cochinchina, Nov. 20, 1932, E. Poilane, U.S.N.M. No. 123/397, 3; Kuala Legap, Plus Valley, Perak, March, 1933, M. W. F. Tweedie, 30+ with *Gastrostomobdella* and *Myxobdella*. Although running smaller than the other lots, the number of sucker rays is very uniformly larger—80–83. Sungai Piah, Perak, Mar. 24, 1932, A. G. Billings, 30+; Trengganu, Raffles Mus. No. 7., 11. In this last lot the median stripe tends to be more continuous and the paramedian stripes send hooked extensions into the dorso-median field.

### ***Hæmadipsa picta* Moore 1929.**

This gayly-colored and distinctive species is widely distributed on the forested mountains of Borneo, being especially characteristic of the zone between 2,000 and 4,000 ft. It is a bush-climbing species, and like the related *H. ornata* of India it is largely solitary and its bite is pungent. With the exception of three specimens from Mt. Matang, the type locality, all in this collection came from Mt. Kinabalu, being represented by single specimens from a number of localities at several stations.

Mt. Matang, Sarawak, No. 2, 3 and 4; Kenokok, Mt. Kinabalu 3,300 ft., Apr. 1929, F.N.C. and H.M.P.; same, Apr. 23, on *Ratufa* sp.; same, Apr. 24; same Apr. 26, 3 specimens; Lumu Lumu, 5,500 ft., Apr.; Marei Parei, 6,000 ft., May 1, H.M.P.

The number of sucker rays on these specimens from the north-east end of the island is somewhat more variable, from 79 to 89, and averages a little larger, about 85, than those from Sarawak previously described. There is also some variation in the color pattern, chiefly in the extent and arrangement of the dark stripes, one of the most unusual being a single specimen from Mt. Matang in which the posterior half of the supra-marginal dark stripe forms a broad brown band reaching across the entire intermediate field to the line of the intermediate sensillæ.

### ERPOBDELLIDAE

### ***Gastrostomobdella vagabunda* sp. nov.**

*Diagnosis.*—Similar in structure, size and form to *G. monticola* Moore. Complete somites sexannulate, consisting of 3 shorter (*b1*, *c11* and *c12*) and 3 longer (*b2*, *a2* and *b5*) annuli.

Genital orifices separated by 9 annuli, the ♂ at XI *b5/c11*, ♀ at XIII *b1/b2*. Gastropore in XIV *a2*, more than 7 annuli behind ♀ pore, undeveloped in young. Color pattern apparently solid without definite spots or stripes. Type locality Plus Valley, Perak, Federated Malay States. (Pl. VII fig. 6, 7).

*Description.*—The material presents a wide range of size and proportions from 24×2.4 to 109×9.8 mm. The type measures—length 83, to ♂ pore 18.6; widths, buccal ring 2.8, ♂ pore 6.6, maximum (XVII) 9, anus 6.2; depths at same points 1.5, 4, 6.6, and 3.2 mm.; sucker 5.4 mm. The largest example from the Larut Hills has the corresponding measurements: 109, 18.6; 3.2, 6.7, 9.8, 5.7; 2, 5.6, 7.4, 4.5; and 5.5, the caudal sucker being more contracted. Immature individuals are more slender, one measuring 52, 12.4; 1.6, 3.2, 4.8, 4; 1.5, 2.2, 3, 2.2, and 3.1 mm. Mature specimens are robust, of rounded, subcylindrical form and nearly uniform diameter throughout the post-clitellar region, with diameter greatest and flattening least near the middle (about somite XVII). Small specimens present more nearly the typical erpobdellid form, being slender and tapering to the head from about somite XIX, most nearly terete except at the ends, but others are depressed throughout.

Head, as in *G. monticola* and other burrowing members of the family, prolonged scoop-shaped and very mobile, the anterior margin or lip spreading and flattened, the sides farther back progressively rolled in ventrad and meeting at the buccal ring. Ventral surface with four broad longitudinal ridges separated by furrows which fork anteriorly to terminate in the notches between the marginal crenulations. The ridges are faintly tessellated and each area bears a sense organ; four rows of labial sense organs are concentrated along the margin of the lip. The sides of the buccal chamber are formed by the faint lobes in which the head annuli terminate laterally and the buccal ring is divided into 6 deep lobes. Dorsally the head and lip is annulated throughout, there being a distinct apical annulus anterior to the first pair of eyes. Eyes 4 pairs, 2 labial situated on annuli 2 and 3 resp., widely separated medially but those of the two pairs close together laterally, both apparently belonging to the outer paramedian or intermediate series of sensillæ; 2 buccal pairs (marginal and supramarginal) close together on the lateral faces of the middle annulus of V; all small, black with the pigment cups deep-set. On the large specimens they are rather obscure, on the small ones conspicuous. Clitellum not evident externally on any of the specimens. Gonopores (Pl. VII, fig. 6, ♂ and ♀) separated by 9 annuli, the ♂ at XI *b5/c11*, the ♀ at XIII *b1/b2* and constant in position on all specimens. On the small leeches the male pore is a small but distinct orifice deep in the furrow, the female a still smaller and less distinct pore, also



in the furrow. The latter undergoes very little change even in the largest and most mature individuals. The male pore increases in size and prominence, becoming, on half-grown specimens, a somewhat elevated, large, transverse slit with margins lobulated by radiating furrows. On the largest individual it is raised on the summit of a prominent, broad-based, conical papilla occupying the full length of annuli XI *b5* and *c11*. On one example 51 mm. long the two sperm ducts open separately, each slightly off of the middle line, the right one in the normal position, the left two annuli caudad at XI/XII; this being the position of the ♂ in *G. monticola*. The gastropore (Pl. VII, Fig. 6, *g.*) varies slightly in position but always within the limits of XIV *a2* and usually  $1/3$  from the cephalic margin, that is, separated from the ♀ pore by seven and a fraction annuli. On the smallest specimens it is totally absent; on those 36 to 51 mm. long it is a slight, transverse, slit-like depression, deeper and wider with increase in size of the leech. On the single mature specimen it is a large and conspicuous, transversely elongated opening with lobed and somewhat protuberant lips on the venter of XIV *a2*. Within the body wall it bifurcates and opens into the digestive tract by a pair of pores as in *G. monticola*. Nephropores are also easily detected on most specimens and on some are elevated on small but distinct papillæ in the ventral intermediate line at the caudal border of *b2* of somites VIII to XXIII inclusive. Anus a rather large opening with radial lobes, at XXVI/XXVII. Caudal sucker of medium size with broad peduncle, discoid and directed ventrad, dorsally rough with numerous small sensory papillæ, ventrally smooth, showing circular and radial muscles and on some specimens a few small sense organs.

*Annulation* well-defined by clear regular furrows especially on the well preserved specimens of medium size in which the difference in length of annuli is constant, although the furrows are nearly uniform in depth. On the mature specimens unequal contraction and distortion obscures the plan. Sense buds are numerous and generally discernible on all annuli, becoming increasingly conspicuous caudad by being elevated on prominent conical papillæ, due to which the caudal end is quite rough. Except that they tend to form two transverse rows on each annulus, those of the posterior row being larger, and are somewhat larger on annuli *b2* and *a2*, there is no definite arrangement. Besides the definite papillæ of various sizes many of the sense organs are not elevated at all. Some of the latter are included in the rows of 18 to 25 and others are scattered irregularly. On the venter the sense organs are similarly arranged but are smaller and rarely elevated on papillæ.

I uniannulate, a distinct preocular ring. II uniannulate, bearing first pair of intermediate or outer paramedian eyes. III biannulate, ( $a1\ a2$ )  $> a3$ . 2nd pair of eyes close to II/III and laterad of 1st pair and probably also of intermediate series. IV like III, no eyes but a transverse series of minute sense organs on each annulus. V 3-annulate,  $a1 = a3 < a2$  with marginal and supramarginal eyes on  $a2$  and a row of sense organs on each annulus. IVa3 and Va1,  $a2$  form lateral buccal lobes and Va3 the buccal ring. VI 3-annulate dorsally, ventrally  $a1$  and  $a2$  unite to form the post-buccal ring and  $a3$  remains distinct. On the type there is a variation on the right dorsal field of this somite by which the furrow  $a1/a2$  disappears. VII 4-annulate ( $a1 = a2 = b5 < b6$ ), ventrally  $b5$  slightly  $< a2$ . VIII 5-annulate,  $a1\ (b1b2) > a2 = b2 > c11 = c12$ ; a faint  $b1/b2$  furrow is much nearer to the anterior margin of  $a1$ ; 1st nephropore. IX 6-annulate,  $b1 = b5 = c11 = c12 < a2 < b2$ . X to XXIV 6-annulate and complete  $b1 < or = c11 = c12 < b2 = a2 = b2$ , that is the first and last two annuli normally are shorter, the middle three longer, but the first may be shorter than the last two or equal to them, the former condition being most evident at the cephalic, the latter at the caudal end of the series. These differences in length of annuli are most obvious on well-preserved half-grown individuals but appear on the adults also, but on the adults in this collection are often obscured by unequal contraction and distortion. Last nephropore on XXIV  $b2$ . XXV 4-annulate,  $a1 = a2 = b5 = b6$ ;  $b5$  and  $b6$  are less separated dorsally but shorter ventrally. XXVI 2-annulate, ( $a1a2$ ) nearly twice  $a3$  with a short  $a1/a2$  furrow at margins. XXVII 1-annulate. Metamerism and constitution of the complete somites verified by dissection of the nerve cord, the ganglia of which lie mainly in  $a2$  but extend into  $b2$ , that of XIV being crowded forward principally into  $b2$  by the gastrostome canal. There is some variation in annulation at the caudal end. XXIV may be 5-annulate by the failure of differentiation of  $c11$  and  $c12$  and XXV may be 3-annulate, ( $a1a2$ )  $> b5 = b6$ . In general the somites at both ends of this species are more elaborately annulated than on *G. monticola*. This is especially the case on the head and on somites XXIV and XXV.

Living color unknown. Preserved specimens gray or light slate color above, light drab or more or less yellowish (cream color) below with indications of more vivid yellow marginal stripes. Except that on some specimens the larger sensory papillæ are yellowish there appear to be no markings.

*Anatomy*.—Pharynx very muscular, reaching to XIV/XV, euthylæmatous with no trace of anterior denticles or stylets. The difference in the musculature of the pharynx between this species and *G. monticola*, in which the muscles are weak, is very

striking and requires further study. The appearance is due in part at least to the poor condition of preservation of the material of the latter which are soft, relaxed and somewhat macerated. At its caudal end the three muscular ridges become subdivided before reaching the pharyngo-gastric annular valve. Except for the slight difference in position the gastropore and canal are exactly as in *G. monticola*.

*Reproductive organs* are similar to those of *G. monticola*. Testes much subdivided into numerous very small (about .75–1 mm.  $\times$  .5 mm.), pyriform or tear-shaped sacs filling the greater part of the parenchymatous space between the gut and the longitudinal muscles and lateral vessels from somite XV to XXV. They are so small and so closely packed that the number could not be determined definitely but was estimated at about 60 on each side of most segments but fewer at both ends of the series. Thirty-eight were counted on both sides of a single section. They taper into short efferent ducts which open into the vas deferens lying close to the ventral longitudinal muscles nearer to the nerve cord than the margins of the body. The vasa deferentia are extremely slender and very slightly sinuous in the testicular somites but anterior to the testes gradually increase to 2 or 3 times the diameter and form rather close spiroid coils but neither of the two not fully matured individuals studied in this respect has the enlarged sperm vesicles usual in the family. They enter the tips of the atrial cornua anterior to which they do not extend. Atrium a short subcylindrical chamber embedded in the ventral muscles beneath the nerve cord and opening below into the male bursa. From its summit arise the pair of relatively large, curved, bluntly conical cornua which diverge caudo-laterally and nearly horizontally, scarcely rising above the level of the nerve cord. The cornua are strongly muscular and have a satiny luster. None of the specimens is fully mature which accounts in part for the smallness of the atrium. The testis sacs contain spermatogonia but no fully mature spermatozoa were seen in any part of the system.

Female organs also very simple, consisting of a short, slender, vertical, common oviduct reaching from the ♀ pore to a point immediately ventral to the nerve cord where it ends in a small globular expansion. From this the paired oviducts pass into the slender, tubular, considerably folded and twisted ovisacs, which extend through the neural sinus to XV/XVI. In the more mature specimen the ovisac and duct of only one side is developed.

The collection includes 13 specimens of this species all from Perak, received through Mr. M. W. F. Tweedie of the Raffles Museum. "Larut Hills, 3,700 ft. Feb. 6–17, 1932, H. M. Pendlebury, Federated Malay States Museum," 1 (the largest)

specimen; "Kuala Legap, Plus Valley, Perak, March, 1933", 1, with *H. S. interrupta* and *M. annandalei*; "Plus Valley, near River Yum, Mar. 18, 1933, 11 specimens including type, with *M. annandalei*."

The association of this species with *Haemadipsa* and *Myxobdella* indicates that it is of amphibious habit<sup>1</sup>, living along streams under stones, etc. and wandering at night to burrow in the soil in search of earthworms and insect larvæ for food. Like many other burrowing leeches, mature individuals are shaped much like earthworms. The development of the gastropore with advance toward maturity indicates a possible function in relation to reproduction.

### **Gastrostomobdella monticola** Moore 1929.

This species, originally described from Mt. Murud, Borneo is represented in the Mt. Kinabalu collection by three specimens taken singly at Lumu Lumu, 5,500 ft. Apr. 1929, F.N.C. and H.M.P.; Lumu Lumu, 5,500 ft. Apr. 7, 1929, H.M.P.; and Pakka, 10,000 ft. Mar. 19, 1929, F.N.C. and H.M.P.

None of these is mature and the gastropore is entirely absent or represented only by a slight slit including a transverse row of minute slits. On all three the male pore is in the typical position at XI/XII but in two the female pore has been shifted slightly caudad into XIII *b1*. On the smallest (30 mm. long) specimen, anterior to XVI the furrows *b1/b2* and *c11/c12* are scarcely developed so that the somites appear to be 4-annulate.

### **Mimobdella büttikoferi** Blanchard.

There is a single specimen of this fine burrowing species taken on Mt. Kinabalu at 8,000 ft., March 20, 1929, F.N.C.

It is well-preserved, extended and very hard. The measurements in mm. are length 146, to ♂ pore 24; widths, buccal 3.6, ♂ pore 5.6, maximum near middle of body 6.8, anus 6.4; depths at same points 3.8, 6, 6.5, 4; sucker 5.5, showing that the body is cylindroid with nearly uniform diameter for most of the length but somewhat flattened caudally, the general shape strikingly like an earthworm. No eyes are visible. The gonopores are separated by  $6\frac{1}{2}$  annuli, the ♂ being at XII *b2* (*c3/c4*), the ♀ at XIII *b1/b2*. There is no trace of a gastropore, complete somites are 10-annulate, the formula as indicated by the position of the nephropores being  $b1 < b2$  (*c3, c4*)  $< a2$  (*b3, b4*)  $> 2$   $d17 < d18 > c10 < c11 = c12$ . The label states the living color as coral red and a water color sketch agrees with scarlet vermilion of Ridgway's color charts, which is close to his coral

1. In the Plus Valley this species, together with *Myxobdella*, was collected in small streams. *Haemadipsa* was abundant in damp jungle, but was never found in water. M.W.F.T.

red. It may be pointed out that the position of the gonopores agrees with Blanchard's description of *Scaptobdella horsti* from Borneo not with those from Sumatra.

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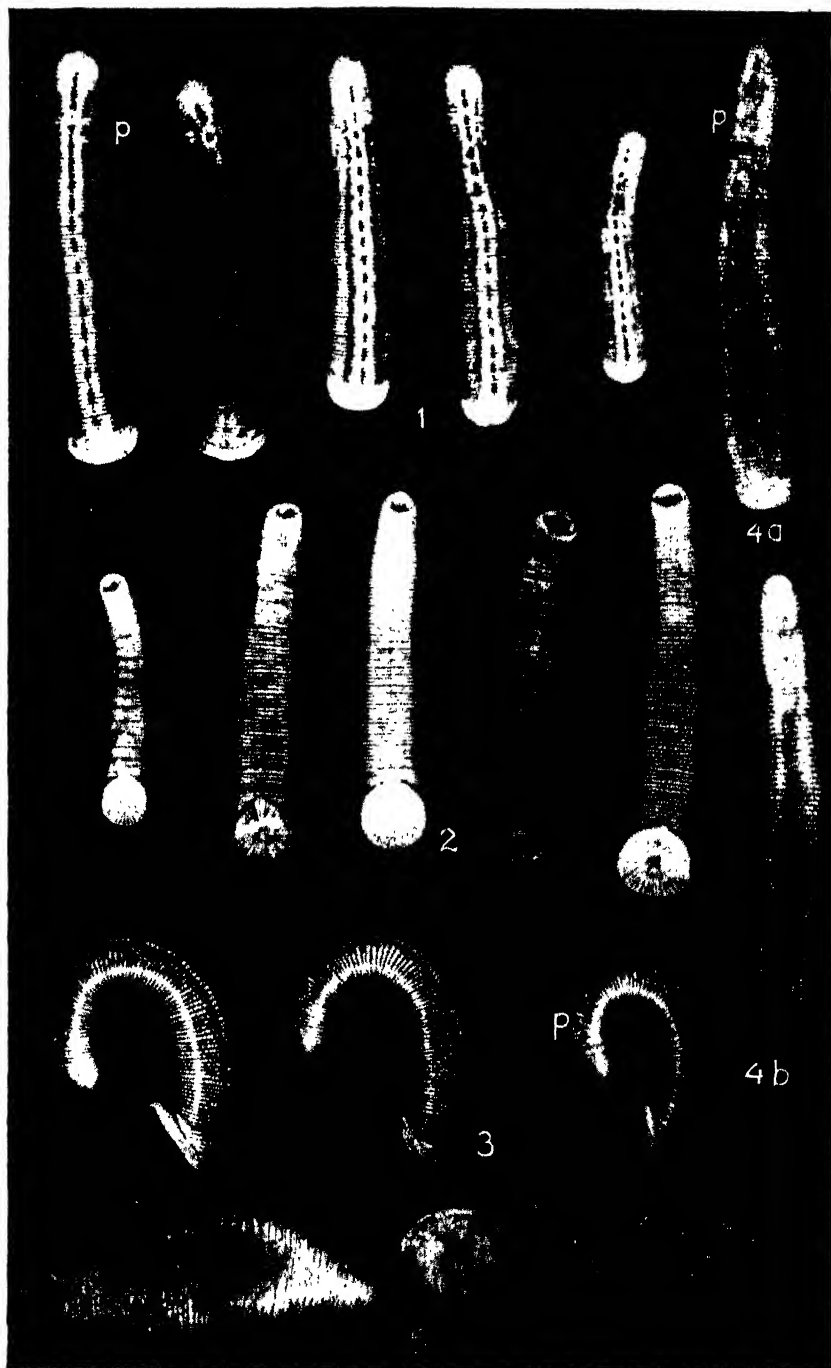
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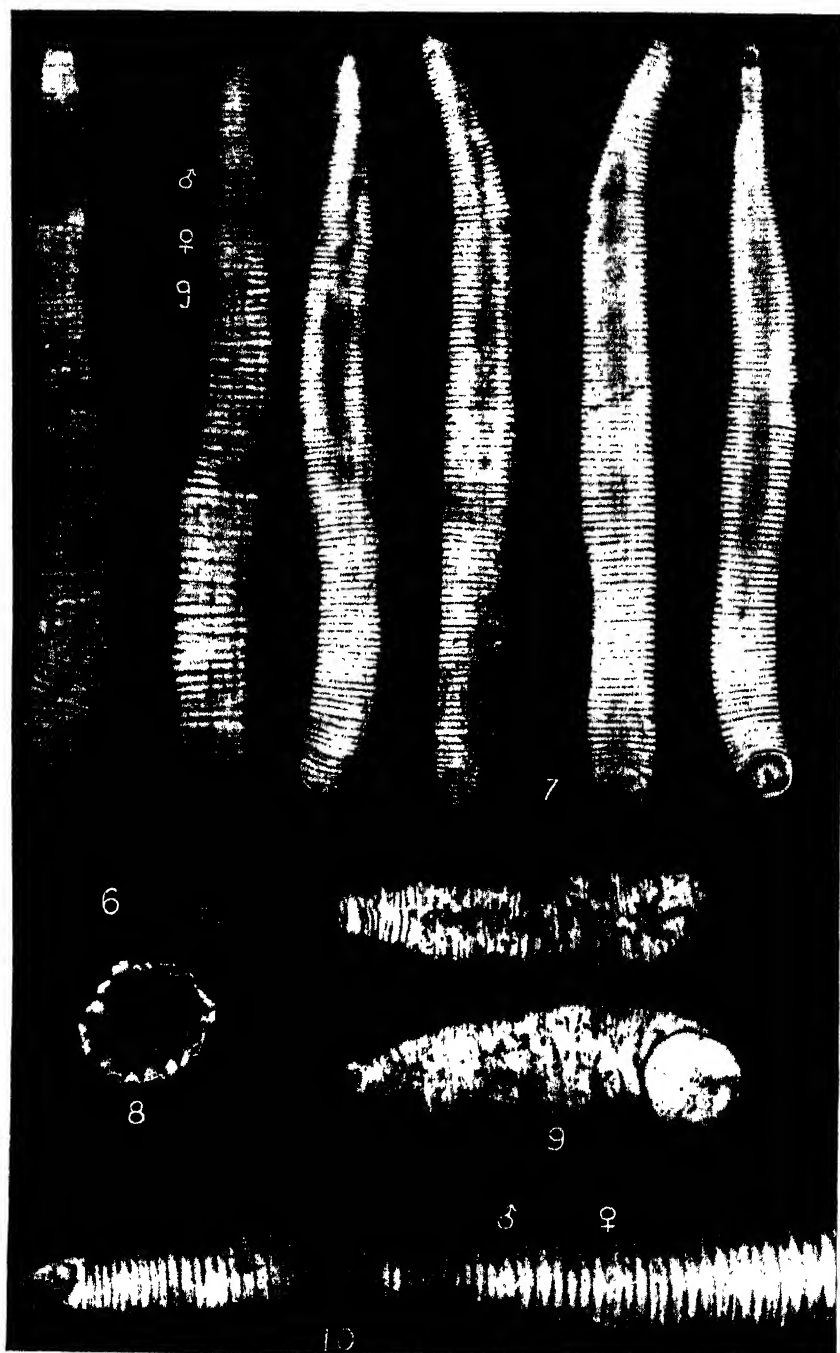
# EXPLANATION OF PLATES

All photographs made under water.

## PLATE VI.

Fig. 1. *Haemadipsa sylvestris interrupta*.—Dorsum of 5 examples from Kuala Legap, Plus Valley, Perak, showing typical color pattern. p—white spots at furrow pits.  $\times 2\frac{1}{2}$ .





LEECHES FROM BORNEO AND THE MALAY PENINSULA

- Fig. 2. Ventral aspect of same specimens. Note especially the prominence at the anterior margin of the caudal sucker.  $\times 2\frac{1}{2}$ .
- Fig. 3. Three examples from the same lot seen from the left side showing the prehensile sucker papilla in different states of flexion and extension.  $\times 2\frac{1}{2}$ .
- Fig. 4a and b. *H. s. interrupta*.—Type specimen from dorsum and venter.  $\times 2\frac{1}{2}$ .
- Fig. 5. *Myxobdella annandalei*.—Dorsal and ventral views of a specimen from River Yum, Plus Valley, Perak, showing the metamerism and annulation.  $\times 2\frac{2}{3}$

PLATE VII.

- Fig. 6. *Gastrostomobdella vagabunda*.—Large example from Larut Hills, Perak, dorsum and venter, natural size. The gastropore (*g*) is at the posterior margin of the cut made to expose the canal leading to the gut.
- Fig. 7. Same, dorsal and ventral views of two from River Yum, Plus Valley.  $\times 2$ .
- Fig. 8. *Haemadipsa* sp. Egg capsule.  $\times 2$ .
- Fig. 9. *Myxobdella annandalei*.—Dorsal and ventral views of a specimen from River Yum, Plus Valley, especially to show color pattern.
- Fig. 10. *Mimobdella biittikoferi*.—Venter of anterior end.  $\times 2\frac{1}{2}$ . ♂, male, and ♀ female pores.
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## On Some Earthworms from East Perak and Christmas Island

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Genus	<i>Drawida</i> Michaelsen	..	..	..
	<i>Drawida</i> species	..	..	..
Genus	<i>Pheretima</i> Kinberg	..	..	..
	<i>Pheretima cameroni</i> Stephenson	1932	..	..
	<i>Pheretima campanulata</i> (Rosa)	1890	..	..
	<i>Pheretima houlleti</i> (E. Perrier)	1872	..	..
	<i>Pheretima indica</i> (Horst)	1883	..	..
	<i>Pheretima polytheca</i> (Beddard)	1900	..	..
Genus	<i>Perionyx</i> E. Perrier	..	..	..
	<i>Perionyx violaceus</i> Horst	1893	..	..
Genus	<i>Glyphidrilus</i> Horst	..	..	..
	<i>Glyphidrilus</i> species	..	..	..
List of species known from the Malay States,				
Singapore and Penang	..	..	..	..
List of species known from Christmas Island	..	..	..	..
References	..	..	..	..

The Director of the Raffles Museum has forwarded for examination a small collection of earthworms which contains representatives of but few species and, with only one exception, no novelties. The opportunity has been taken to incorporate in the report on this collection comments on a few of the Peninsular species together with a list of the forms known from this portion of the world.

The author's thanks are due to the Director of the Museum for the opportunity of examining the collection.

### Genus *Drawida* Michaelsen.

#### *Drawida* species.

Kuala Legap, Plus Valley, E. Perak. March 1933.  
1 juvenile specimen.

*External characteristics*.—Length, 29 mm. Diameter, 2 mm. Unpigmented.

The prostomium is prolobous, attached to the roof of the buccal cavity beneath intersegmental furrow 1/2.

The setæ begin on ii and are closely paired;  $ab=cd$ , in the midbody segments,  $aa<bc$ .

The spermathecal pores are minute, in 7/8, in or just median to c.

The male pores are minute, in *bc* but much nearer to *b* than *c*, on the ventral ends of small, conical porophores on which intersegmental furrow 10/11 is lacking. The porophore is formed by a protuberance from the posteriormost margin of *x* and the anteriormost margin of *xi* and extends from mid *bc* to *b*. The male pores are about in line with 10/11.

The nephridiopores are in *d* or just dorsal to *d*.

Genital markings are lacking.

*Internal anatomy.*—The gizzards are three, in segments xiv to xvi. The gut is very narrow in *xx*, abruptly widened to full intestinal diameter in *xxi*. The last hearts are in *ix*.

The testis sacs are firm and small, in 9/10, projecting equally into both *ix* and *x*. The vas deferens is, relative to the size of the worm, fairly thick and very long. It is twisted into a considerable mass of loops in *ix* at the side of the oesophagus, the massed loops in contact with both 8/9 and 9/10. There are further massed loops in *x*. The vas passes into the prostate well below the ental end of the latter. The prostates are erect, *i.e.*, not sessile or bound to the parietes and each comprises an ental, thickly sausage-shaped portion slightly bent into a crescentic curve and a narrower, much shorter stalk. The coelomic surface of the outer layer has an appearance suggestive of fine granulations but the layer is closely adherent to the central body and can be scraped off therefrom only with difficulty. The shape of the central body is approximately the same as that of the prostate before removal of the external layer. The central body is tough, with a thick wall and very narrow lumen which is circular in section. The prostates are large, relative to the size of the worm, that of the right side passes under the gut and into the left side of *x*; that of the left side passes through the periesophageal annulus mesial to the ovarian chamber and into *xii*.

The ovarian chamber is probably horseshoe-shaped but is empty, *i.e.*, without free ova. The ovisacs are confined to *xii* and are also empty.

The spermathecal ampullæ are smallish but are filled with whitish material with a brilliant iridescence. The atria are tubular, shortly finger-shaped, erect on the anterior face of 7/8, with very short and slender stalks just at the parietes into which the spermathecal ducts pass. The atrium on the left side is probably abnormal (cyst-like bodies in its tissues) while the atrium of the right side may not have attained its definitive form.

*Remarks.*—The erection of a new species, especially in the genus *Drawida*, for a single, juvenile specimen of uncertain age, in which the spermathecal atria may be deformed as a result of the presence of parasites, cannot be justified. The worm

described above does, however, appear to be distinct from all of the Burmese Drawidas.

Species of *Drawida* which at present appear to be endemic are known from China, French Indo-China, Burma and India. One, apparently endemic species is known only from Victoria Point in the southernmost portion of the province of Burma. Although endemics may not be as frequent east of the occidental margin of the Shan Plateau as to the west, yet there is no reason immediately obvious for the absence of such species from the Peninsula and mainland Siam. Michaelsen would, of course, explain the absence of *Drawida* from the areas just mentioned in accordance with his theory of *Pheretima*-dominance, but the evidence for this theory is, at present, nothing more than the very fragmentary character of our knowledge of the earthworm fauna of south-eastern Asia. The failure of collectors hitherto to secure representatives of this important Asiatic genus in the Peninsula and in mainland Siam is due probably to a restriction of collecting to densely populated areas, cultivated land or other unfavourable localities.

### Genus *Pheretima* Kinberg.

#### *Pheretima cameroni* Stephenson.

*Pheretima indica* var. *cameroni* Stephenson 1932, Bull. Raffles Mus. No. 7, p. 47. (Type locality, Tanah Rata, Pahang. Type in the British Museum).

Variety *cameroni* differs from *P. indica* (Horst) 1883 as follows.—(1) Larger setal numbers: vii/24; 49/v, 65/ix, 76/xii in contrast with vii/12-15; 32-42/viii, 40-44/xii, 38-43/xx. (2) Absence or rudimentary character of septum 8/9. (3) The annular, unpaired testis sac of x, in contrast to paired, ventral testis sacs in *indica*. (4) The unpaired, cylindrical testis sac of xi, in contrast to paired, suboesophageal testis sacs in *indica*. (5) The inclusion of the anterior seminal vesicles within the testis sac of xi. (6) Absence of copulatory chambers. (7) Junction of the diverticulum with the spermathecal duct close to the parietes, rather than near the ampulla. (8) Absence of a nephridial "fur" on the spermathecal duct.

There may be further differences in the male genital terminalia of xviii in the two forms, but the type of *cameroni* was "in very bad condition" and Stephenson did not indicate whether the male pores of his variety are to be regarded as superficial or invaginate. In either case the differences noted above certainly and clearly differentiate *cameroni* from *indica*.

#### *Pheretima campanulata* (Rosa) 1890.

*Pheretima campanulata* Stephenson 1930, J. F. M. S. Mus. vol. 16, p. 273.

Stephenson was not quite certain as to his identification of a specimen from Kuala Lumpur referred to this species.

Through the kindness of Dr. C. C. A. Monro this particular specimen which is in the British Museum has been examined by the writer. As a result it is possible to confirm Stephenson's identification. The Kuala Lumpur specimen is characterized by the biglandular arrangement in connection with each spermatheca, the trilobed ventral end of the penial body or male porophore in the copulatory chamber, and by the presence of penial setæ in the wall of the copulatory chamber. Stephenson noted that "penial setæ were not searched for" (p. 273). Penial setæ are very rare in the genus *Pheretima* and in this particular case serve, at least so far as normal specimens are concerned, to differentiate *P. campanulata* from *P. houlleti* with which it has been confused.

***Pheretima houlleti* (E. Perrier) 1872.**

*Pheretima houlleti* Stephenson 1932, Bull. Raffles Mus. No. 7, p. 45.

Stephenson notes, after a description of a specimen from Kuala Lumpur, and a reference to the two species *P. houlleti* and *P. campanulata*, that "The present specimen is about half way between the two; I choose the older name for it. It would seem to be still slightly doubtful whether the distinction between the two is as clear cut as Gates supposes." (p. 47). The three major characteristics distinguishing *houlleti* from *campanulata* are (1) the monoglandular apparatus in connection with each spermatheca, (2) the absence of penial setæ in the wall of the copulatory chamber, and (3) the absence of the trilobulation of the ventral end of the penial body or male porophore within the copulatory chamber. Examination of long series of specimens has shown quite clearly that there is no intraspecific variation with respect to these three characteristics, at least so far as normal specimens are concerned. It is evident from Stephenson's description (note, monoglandular apparatus on each spermatheca and absence of penial setæ) that his worms are to be referred to *P. houlleti*. No information is given as to the shape of the penial body but this is, perhaps, not of great importance in view of the definite evidence of the other two characters. The specimens as to which Stephenson was doubtful can be considered "half way between the two" species only so far as characteristics of minor specific importance which are known to vary within both species, are concerned.

***Pheretima indica* (Horst) 1883.**

*Perichaeta floweri* Benham 1897, J. Linn. Soc. London, vol. 26, p. 217. (Type locality, Bukit Timah, Singapore. Types in the British Museum).

*Pheretima floweri* Michaelsen 1900, Das Tierreich, vol. 10, p. 267.

*Pheretima floweri* Gates 1934, Rec. Indian Mus., vol. 36, p. 258 (After examination of the types).

*Amyntas peregrinus* Beddard 1900 (part), Fauna Hawaïensis, vol. 2, p. 414. Proc. Zool. Soc. London, 1900, p. 644. (Excluding *peregrina* and *molokaiensis*).

Christmas Island. Aug.-Sept. 1932. 8 clitellate specimens.  
 Kuala Legap, Plus Valley, E. Perak. March 1933.  
 9 clitellate specimens.  
 River Yum, Plus Valley, E. Perak. March 1933.  
 3 clitellate specimens.

*External characteristics.*—Length, 75–170 mm. Diameter, 3–5 mm.

The setæ begin on ii on which segment there is a complete circle; more or less obviously enlarged on ii-ix or iii-viii, usually more conspicuously protuberant on iii-viii, gradually decreasing in size passing posteriorly. The setal numbers are indicated in the table below.

## SETAL FORMULÆ

	vi	vii	viii	xvii	xviii	xix	viii	xii	xx
1. ..	14	16	16	13	8	15	38	43	43
2. ..	12	13	14	13	10	**	37	40	40
3. ..	5(+4?)	15	14	14	8	13	42	44	41
4. ..	13	14	12	14	9	13	33	**	**
5. ..	12	14	16	13	8	14	37	44	41
6. ..	12	12	11	14	8	14	37	43	38
7. ..	10	6+	11	13	9	14	32	42	41
8. ..	12	12	13	13	10	15	40	40	**
9. ..	12	13	12	12	9	14	—	—	—
10. ..	11	13	12	13	9	14	—	—	—
11. ..	13	14	13	16	10	15	—	—	—
12. ..	11	14	13	—	8	—	—	—	—

(+4?)—4 setal pits in which no setæ are visible.

—gaps in setal circle, no setal pits recognizable.

\*\*—setæ not counted because of wide gaps in setal circle.

Formulæ 1 to 7 are of Peninsular specimens, 8 from a Christmas Island specimen, 12 from a type of *floweri*, 9 of a specimen from Lawai, Obi Island, Moluccas, 10 of a specimen from Ovalau, Levuka, Fiji Islands, 11 of a specimen from Batoran, Luzon, Philippine Islands.

The first dorsal pore is in 11/12 (1), 12/13 (10).

The clitellum is annular, extending from 13/14 to 16/17 or not quite reaching to 13/14 or 16/17 (3 specimens); setæ (except ventrally on xvi on the type of *floweri*), dorsal pores and intersegmental furrows lacking.

The external apertures of the spermathecal battery are small, less than 1 intersetal interval in width, transversely placed, slit-like to oval; 4 pairs, in 5/6-8/9.

There is but one female pore.

The apertures of the copulatory chambers are transversely slit-like to roughly circular; margins crenate.

Genital markings are lacking, externally.

*Internal anatomy.*—(Examined 15 specimens). Septum 8/9 is present and complete but membranous, almost perfectly transparent; 9/10 lacking; 10/11-13/14 slightly muscular.

The intestine begins in xv just anterior to 15/16 or in xvi immediately posterior to 15/16. The intestinal cæca are simple, extending from xxvii into xxiii, xxiv or xxv; margins smooth except for septal constrictions. In one specimen there are, posteriorly, three very small lobulations of the ventral margin of each cæcum.

The last pair of hearts is in xiii (15). There is a pair of hearts belonging to segment ix (1) or a single heart on the right side (7) or on the left side (7). There are no hearts or dorso-ventral commissures belonging to segment x. The hearts of ix, xi-xiii all pass into the ventral vessel.

The testis sacs of x and xi are ventral and paired, the members of a pair usually fairly widely separated but in several specimens the sacs of xi are separated by a distance only very slightly greater than the diameter of the ventral blood vessel. The seminal vesicles of xi and xii are each provided with a dorsal ampulla which has a bluntly round base sunk into a deep cleft in the dorsal margin of the ventral lamina, the ampulla tapering dorsally to an almost pointed termination. The pseudovesicles of xiii vary in size from rudimentary to about half the size of the seminal vesicles of xii. In number 3 each of the pseudovesicles of xiii has a dorsal ampulla with shape and attachment as in the vesicles of xii. The pseudovesicles of xiv are lacking or are represented only by tiny rudiments.

The prostates vary considerably as to size and segmental extent and are confined to xviii (2) or extend through xvii-xviii only (2) or xvi-xviii (1) or from xviii into xix, xx, xxiii or xxv. The duct is short, only about 2 mm. in length; straight or almost straight. The appearance of the copulatory chambers varies according to the degree of retraction or eversion. When fully retracted the chambers are rather conspicuously protuberant into the cœlom and elongately ovoidal but with both ends bluntly rounded. The chamber is partially imbedded in the parietes but can be dissected out rather easily except for a short stalk from the midventral face that encloses the passage to the exterior. From the roof of the copulatory chamber there hangs down into the lumen a slenderly conical penis about 2 mm. long. There is no pore at the ventral tip of the penis but on the posterior face of the penis, at the base near the roof of the chamber there is a very slight, vertical fissure the margins of which are in contact. On separation of the margins of this cleft the male bore becomes visible in a dorsal portion of the fissure. The male pore fissure is not easily distinguished at first glance from purely adventitious wrinkles on the surface of the penis but after examination of several specimens the fissure can be identified by slight differences which are extremely difficult to describe. The prostatic duct passes through the roof of the

copulatory chamber into the dorsal portion of the penis and this part of the male organ is firm and usually with a smooth surface. Ventral to the male pore the penis is softer, flabby, often with a semi-collapsed appearance and folded back on itself. In several specimens from the Peninsula the prostatic duct of one or of both sides passes into the copulatory chamber on the lateral face close to the parietes rather than into the middle of the dorsal face. In such chambers the penis is 'erected' or inverted and dorsally directed, the tip in contact with the roof of the chamber, the base of the penis attached ventrally and laterally to the wall of the chamber. In another specimen, also from the Peninsula, each penis has been compressed against the roof of the chamber and there flattened out into a disc-shaped body of longitudinally oval outline with little resemblance to a normal penis. If this particular specimen were an unique type, the species, almost certainly, would be erroneously characterized.

A large part of the copulatory chamber is taken up by two glands, one located in the anterior wall, the other in the posterior wall of the chamber. The external apertures of these glands are located in slight depressions at the centres of two, circular genital markings. The marking may be indistinctly delimited from the wall of the chamber or sharply demarcated; in the latter case the marking may be only slightly protuberant or conspicuously protuberant into the lumen and held out, as it were, from the wall on a broad but very short stalk. In a specimen in which the markings all have this stalked appearance the disc of each marking is folded lateromesially along a central axis into a deep vertical groove. The two grooves thus formed from the anterior and posterior genital markings are in contact in the middle of the chamber and surround the penis as a sort of sheath. The pore in the depression at the centre of each genital marking leads anteriorly or posteriorly into a small but irregular lumen at the centre of the gland. In a completely retracted copulatory chamber the glands do not appear to be different from those in the same locations in *P. montana*.

Several specimens have one or both copulatory chambers in various stages of eversion. An anterior or posterior portion of the stalk of the chamber may be everted as a rounded "tag", the anterior or the posterior genital marking may be protruded, or the penis and one of the markings may be visible externally. Both chambers of one worm are completely everted. Each male porophore on this worm has the appearance of a longitudinally placed, conspicuously protuberant disc, oval in outline and with a flattened ventral surface from which project two stalked genital markings and the penis. The markings are towards the median side of the porophore, the penis towards the lateral side and about equidistant from each of the markings. Internally, in

## EARTHWORMS FROM EAST PERAK AND CHRISTMAS ISLAND

this specimen, there is no evidence of the existence of copulatory chambers, the prostatic duct passing directly into the parietes as in species with superficial male pores.

The spermathecal ampulla is small and joined to the apparently thicker and actually longer duct by a narrow neck. Mixed throughout the whitish material within the ampulla are soil particles. The neck and an ental part of the duct including the diverticulum-duct junction is covered over by a "fur" of nephridia. The thickness of this fur is variable. The nephridia and associated connective tissue can be dissected off from the duct and must be removed in order to demonstrate the neck. An ental portion of the duct is barrel-shaped. Deep within the parietes the duct is usually abruptly narrowed, the narrowed portion anteroposteriorly compressed. In one, slightly macerated specimen the duct is not, apparently, abruptly narrowed in the outermost portion of the parietes. After separation of the longitudinal muscle fibres the duct can be pulled out from the parietes leaving a transversely oval aperture with smooth margin in the epidermis. In specimen four the margins of the spermathecal pores are swollen and conspicuously protuberant, the aperture between each pair of tumescences transversely crescentic but here too the aperture left in the epidermis after pulling out the duct is oval.

The wall of the duct is thick, the lumen eccentric, small and in section crescentic. The position and shape of the lumen results from the development of a strong vertical thickening of a portion of the wall into an internal ridge that is bluntly rounded. A cross section through the duct entally shows the ridge on the lateral wall.

Further ectally a section through the duct shows the ridge or thickening anterolaterally while still nearer the parietes the thickening may be almost if not quite anterior.

The diverticulum is small and consists of an ovoidal, terminal seminal chamber and a longer but very slender stalk. The latter passes into the duct below the neck but quite definitely dorsal to the parietes. Supernumerary seminal chambers (lateral) are present in all of the Christmas Island specimens that were opened, the number of these chambers varying from one to three. An occasional spermatheca may have only the terminal chamber. There are no accessory chambers in the specimens from the Moluccas, the Fiji Islands and the Philippines that were compared with the Raffles Museum specimens. The Peninsular forms may be characterized by either of the conditions just mentioned or by various phases of a condition intermediate between these two extremes, as shown below. (Peninsular specimen # 1). Two lateral seminal chambers on each diverticulum of the spermathecae of viii and ix, no extra chambers on



the diverticulæ of spermathecæ of vi and vii. (2) Extra chambers present on the diverticula of some spermathecæ, lacking on others. All lateral chambers are small, transparent or with spermatozoal iridescence. The ental end of the main seminal chamber is normal, bilobed or trilobed. (3) Terminal seminal chambers unusually large, ental ends normal; no lateral seminal chambers. (4) Each diverticulum has one or two extra seminal chambers; none of the chambers, either lateral or terminal, with spermatozoal iridescence. (5) Each diverticulum has one, two or three accessory chambers. (6) Each diverticulum has one, very small, scarcely recognizable, lateral seminal chamber. (7) No lateral seminal chambers, stalks of lateral seminal chambers present but without trace of terminal dilation.

The supernumerary chambers appear at first glance to be very shortly stalked, almost sessile on the stalk of the terminal chamber. Removal of connective tissue is, however, usually possible, thereby disclosing more ectal portions of the secondary stalks that pass ventrally for varying distances on the main stalk. Two or three lateral seminal chambers are always arranged in a vertical row on the main stalk just below the terminal chamber. No instances of alternate arrangement of the lateral chambers were found.

One or both of the ovaries may be hypertrophied as the result of the presence of numbers of small parasites, the enlarged gonads reaching to or nearly to the dorsal parietes. The oviducal funnels are narrowly ribbon-shaped strips placed vertically on the anterior face of 13/14. Toward the ventral end of the band or strip is a depression which is, presumably, the opening of the funnel.

*Parasites.*—In number three (Peninsular) there are numerous, very small, whitish, ovoidal cysts in the cœlomic cavities of several segments. Ovarian parasites have been noted above.

*Diagnosis.*—*Pheretima indica* can now be defined as follows. Octothecal: external apertures of the spermathecal battery transversely oval, less than 1 intersetal interval in width, 4 pairs, in 5/6-8/9. Setæ: vi/9-14, vii/12-16, viii/12-16, xvii/12-16, xviii/8-10, xix/13-15; 32-42/viii, 40-44/xii, 38-43/xx. First dorsal pore in 12/13. Male pores invaginate, each pore in a vertical fissure on the posterior face and near the base of a slenderly conical penis protuberant into the lumen of the copulatory chamber from the roof. No external genital markings, an anterior and a posterior, circular, genital marking within each copulatory chamber.

Septum 8/9 present, membranous. Intestinal cæca simple. Hearts of x lacking. Testis sacs of x and xi paired and ventral.

Genital marking glands imbedded within the anterior and posterior walls of the copulatory chamber. Spermathecal ampulla shorter than the barrel-shaped, thick-walled duct. Diverticulum small; seminal chamber ovoidal and shorter than the slender stalk, lateral seminal chambers present or absent, stalk into duct entally.

*Remarks.*—Octothecal forms with spermathecal pores in 5/6-8/9, well developed copulatory chambers, without external genital markings have been referred by various authors to different species; *cingulata* Schmarda 1861, *darnleiensis* Fletcher 1886, *vaillanti* Beddard 1890, *martensi* Michaelsen 1892, *padasensis* Beddard and Fedarb 1895, *eo*a Rosa 1896, *madelinae* Benham 1897, *floweri* Benham 1897, *belli* Rosa 1898, *decipiens* Beddard 1912, *kuchingensis* Stephenson 1916. Michaelsen (1922 and 1928) has suppressed all of these names except *floweri*, *belli* and *decipiens*. Now that the characteristics of the male genital terminalia of xviii in *indica* are known there is no longer any justification for the retention of *floweri*. *P. belli* cannot be distinguished at present from *indica* by any characteristics of specific importance and probably should be suppressed. *P. decipiens* is inadequately characterized but is almost certainly, in part, if not entirely, synonymous with *indica*. Both Michaelsen and Ude regard *atheca* Rosa 1896 as a synonym of *indica*, but it might be regarded with almost equal justification as a synonym of *campanulata*. Stephenson's variety of *indica* is specifically distinct (*vide P. cameroni* on a previous page).

***Pheretima polytheca* (Beddard) 1900.**

*Amyntus minutus* Beddard 1900, Proc. Zool. Soc. London, 1900, p. 906. (Type locality Aring, Kelantan. Holotype in the British Museum).

*Pheretima minuta* Stephenson 1932, Ann. Mag. Nat. Hist. ser. 10, vol. 9, p. 222. (After examination of the holotype).

No differences of specific importance are apparent in the original descriptions of *polytheca* and *minuta*. Beddard's definitions of the two forms are almost identical. Stephenson, after examination of the types of both species was, apparently, unable to record any characteristic that might enable discrimination between the two forms. *P. polytheca* has page priority over *P. minuta*.

Genus ***Perionyx*** E. Perrier.

***Perionyx violaceus* Horst 1893.**

River Yum, Plus Valley, E. Perak. March 1933. Under wet leaves on a flat rock by the edge of the River Yum. 10 clitellate specimens or anterior fragments.

River Yum, Plus Valley, E. Perak. March 1933. 5 clitellate specimens.

*External characteristics.*—Length, 37–65 mm. Diameter, 2 mm. Colour, reddish with a dark, blueish tinge dorsally. The first dorsal pore is in 4/5.

The clitellum is whitish, annular and extends from 12/13 to 16/17; intersegmental furrows and setæ present but dorsal pores occluded.

The spermathecal pores are two pairs, in 7/8–8/9, the pores close to the midventral line; on segment viii one or two setæ between the spermathecal pore lines. The single female pore is presetal and median on xiv.

Midventrally on segment xviii there is a relatively deep, depressed area. The depression may be longitudinally oval in outline but when most sharply demarcated is diamond shaped, the long axis of the depression in the midventral line. The depression extends across the entire length of xviii. The equatorial band on which the setæ are located is continued, on each side, into the depression as a slight ridge, the ridges reaching almost to the midventral line. On some specimens the medianmost portion of each of these ridges appears to be cut off as a circular protuberance, almost a papilla. At the centre of each of these papillæ or the corresponding portion of the uninterrupted ridge is a tiny aperture, presumably the male pore.

There are no other genital markings.

*Internal anatomy.*—(Examined four specimens). The gizzard is rudimentary. The gut is narrow and not clearly differentiated from the œsophagus through segment xviii, widening rather gradually in xix, attaining its maximum diameter only in xx.

The last pair of hearts is in xii.

The testes and male funnels are free, in x and xi. Segment x is filled with a testicular coagulum closely compacted into a single whitish mass that is adherent to the parietes, gut and septa and which resembles an annular or horseshoe-shaped testis sac. Segment xi is similarly filled by a closely compacted adherent mass of coagulum in which are imbedded the small, lobulated, seminal vesicles of the segment. The coagulum must be broken up to find these vesicles. The seminal vesicles of xii are larger and without marked lobulation, in contact middorsally above the gut; either extending into xiii or pushing 12/13 back into contact with 13/14. The prostates are confined to xviii. The prostatic duct is about  $1\frac{1}{2}$  mm. long, slightly looped or spirally twisted, slender entally, thickened ectally, a small portion just at the parietes almost conical in shape.

The spermathecae are relatively large and reach to the dorsal parietes but do not come into contact middorsally. The ampullæ

which are distended by a dull, whitish material within are almost sessile on the parietes, near which they are gradually narrowed; a duct scarcely recognizable as such until just at the parietes at the diverticular junction. The diverticulum is of the same shape and about half as large as the spermatheca. There is no definite, external demarcation into stalk and seminal chamber except for a very short, stalk-like portion close to the duct. The seminal chamber is filled with a whitish material characterized by a brilliant iridescence. The diverticulum of each spermatheca is on the lateral (opposite to median) side.

### Genus *Glyphidrilus* Horst.

#### *Glyphidrilus* species.

River Yum, Plus Valley, E. Perak. March 1933. Under wet leaves on a flat rock by the edge of the River Yum. 9 tail portions or fragments from the posterior portion of the body.

The characteristic conformation of the body and the setal distribution enables the reference of these fragments to the genus *Glyphidrilus*. Only one species of this genus has been recorded from the Peninsula, *G. Malayanus* Michaelsen 1902, erected for two specimens only one of which is complete. In spite of the fact that these worms "zu Millionen . . . . . unter Wasser lebend" only the two types have been available for study. The species doubtless is, like others of the genus, extremely variable and in consequence cannot be adequately characterized until more is known of the extent of variation of certain important characteristics. In connection with this species Michaelsen remarks (1902, p. 37) "Es muss bei dieser Sachlage bedauerlich erscheinen, dass der Sammler dieser Art von den Millionen Thieren, die ihm zur Verfügung standen, nur zwei mitnahm; aber auch für diese zwei Exemplare sei ihm Dank gesagt."

*G. malayanus* is distinguished, at present, from the Burmese *G. papillatus* by the absence of the seminal vesicles of ix, the restriction of the spermathecae to paired groups of two rather than paired groups of five and the absence of spermathecal pores in 13/14.

#### LIST OF THE SPECIES OF EARTHWORMS HITHERTO RECORDED FROM THE MALAY STATES, SINGAPORE AND PENANG

*Megascolex mauritii* (Kinberg) 1867.

Kuala Lumpur, Selangor; Singapore.

*Pheretima*

\**arangeana* (Beddard) 1900.

Aring, Kelantan. (Known only from the types).

- \**baruana* Stephenson 1932.  
Khota Baru, Kelantan. (Known only from the types).
- bicineta* (E. Perrier) 1875.  
Penang.
- \**bipora* (Beddard) 1900.  
Malay Peninsula. (Type locality unknown. Known only from the types).
- \**brinchangensis* Stephenson 1932.  
Brinchang Road, Pahang. (Known only from the types).
- \**cameroni* Stephenson 1932.  
Tanah Rata, Pahang. (Known only from the holotype).
- campanulata* (Rosa) 1890.  
Kuala Lumpur, Selangor.
- \**dunckeri* Michaelsen 1902.  
Lubok Paku, on the Pahang River. (Known only from the types).
- hawayana* (Rosa) 1891.  
Kuala Lumpur, Selangor; Singapore.
- houlleti* (E. Perrier) 1872.  
Aring, Kelantan; Kuala Lumpur, Selangor.
- indica* (Horst) 1883.  
Aring, Kelantan; Batu Caves, Selangor; Fraser's Hill, Pahang; Gunong Pulai, Johore; Plus Valley, E. Perak; Singapore.
- \**malayana* (Beddard) 1900.  
Aring Kelantan. (Known only from the types).
- morrisi* (Beddard) 1892.  
Penang.
- peguana* (Rosa) 1890.  
Singapore and Penang.
- planata* Gates 1926.  
Kuala Lumpur, Selangor.
- \**polytheca* (Beddard) 1900.  
Aring, Kelantan. (Known only from the types).

EARTHWORMS FROM EAST PERAK AND CHRISTMAS ISLAND

*posthuma* (L. Vaillant) 1868.

(Recorded by Beddard from the Malay Peninsula, no definite locality stated).

\**pulauensis* (Beddard) 1900.

Pulau Bidan, Kedah. (Known only from the types).

*Perionyx*

*excavatus* E. Perrier 1872.

Kuala Lumpur, Selangor; Tanah Rata, Pahang; Taiping.

*violaceus* Horst 1898.

Fraser's Hill, Pahang; Plus Valley, E. Perak.

*Octochaetoides*

*fermori* (Michaelsen) 1907.

Kuala Lumpur, Selangor.

*Dichogaster*

*bolawi* (Michaelsen) 1891.

Kuala Lumpur, Selangor.

*modiglianii* (Rosa) 1896.

Kuala Lumpur, Selangor.

*saliens* (Beddard) 1892.

Singapore and Penang.

*Ocnerodrilus*

*occidentalis* Eisen 1878.

Singapore.

*Eukerria*

*kükenthali* Michaelsen 1908.

Batu Caves, Selangor.

*Pontoscolex*

*corethrurus* (Fr. Müller) 1857.

Kuala Lumpur, Sungei Buloh, Selangor;  
Tanah Rata, Pahang; Gunong Pulai,  
Johore; Taiping Hills; Penang and  
Singapore.

*Glyphidrilus*

*malayanus* Michaelsen 1902.

Lubok Paku, Pahang River.

Listed above are twenty-nine species. Of this number, twenty must be considered, according to present standards, as having very little or no zoogeographical significance. The remaining nine species (marked with an asterisk) all belong to the genus *Pheretima*. Each of these species is known only

from the types and from the type localities. The absence of *Drawida* from the list has already been commented upon in an earlier portion of this paper. That there is much yet to be done in connection with working out the earthworm fauna of the region under consideration must be obvious. It may perhaps be permissible to express the hope that this can be attempted before the growth in population, the increase of cultivation and the extension of other unfavourable influences have too greatly affected the character of this fauna.

Although Christmas Island is included politically within the Straits Settlements it is at some distance from the mainland and intervening between it and the mainland is the island of Java. The species from Christmas Island are accordingly listed separately. With the single possible exception of *Pheretima brevis*, all species on this list are widely spread, peregrine forms.

#### EARTHWORMS OF CHRISTMAS ISLAND

##### *Pontodrilus*

- bermudensis* Beddard 1891.
- matsushimensis* Iizuka 1898.

##### *Pheretima*

- bicincta* (E. Perrier) 1875.
- \**brevis* (Rosa) 1898.  
(Known only from the types and only from Christmas Island.)
- indica* (Horst) 1883.
- posthuma* (L. Vaillant) 1868.
- rodericensis* (Grube) 1879.

##### *Ramiella*

- cultrifera* Stephenson 1931.

##### *Dichogaster*

- bolawi* (Michaelsen) 1891.
- papillata* (Eisen) 1896.
- saliens* (Beddard) 1892.

##### *Eukerria*

- kükenthali* (Michaelsen) 1908.

##### *Pontoscolex*

- corethrurus* (Fr. Müller) 1857.

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## Notes on a Collection of Terrestrial Mollusca from Christmas Island

By F. F. LAIDLAW, M.A.

Both Mr. J. R. le B. Tomlin and Dr. B. Rensch have given me kind and valuable assistance in drawing up the following list which is chiefly based on material collected by Mr. M. W. F. TWEEDIE in 1932 and I have the pleasant duty of offering them here my grateful thanks for their help.

The molluscan fauna of Christmas Island has been dealt with chiefly by the late E. Smith.

References to his papers on the fauna are as follows:—

Smith E., 1887. Proc. Zool. Soc. London, pp. 517-519.

1888. *ibid.* pp. 536-538.

1900. *ibid.* pp. 117-118.

1900. Christmas Island Monograph, pp. 54-59.

1905. Ann. Mag. Nat. Hist. 16, p. 551.

1909. Proc. Malac. Soc. VIII, pp. 369-372.

1910. *ibid.* IX, pp. 315-318.

Other references are few, all that I have been able to find are given below.

Laidlaw, F. F., 1930. Proc. Malac. Soc. XIX, p. 176.

(note on *Sitala? normani* Smith).



## TERRESTRIAL MOLLUSCA FROM CHRISTMAS ISLAND

Rensch, B., 1931. (Zool. Jahrb. 61, p. 378).

(suggests that the form described by Smith under the name *Leptopoma mouhoti* Pfr. is probably an undescribed race of *Japonia* (?) *wallacei* Pfr.).

Jutting, T. van B., 1932 Journ. of Conch. XIX, p. 206, Pl. VII, fig. 12. (records *Succinea listeri* Smith from Java).

### ELLOBIIDÆ

#### **Pythia nux** Reeve.

Numerous specimens of all ages, some preserved in spirit, from debris and detritus.

The species is evidently abundant. It is not recorded by Smith, who however lists *scarabaeus* L. a similar but larger species. Mr. Tomlin to whom I owe the identification of these specimens has very kindly searched for the material studied by Smith in order to determine whether *scarabaeus* actually occurs, or whether Smith's examples should have been correctly referred to *nux*. Unfortunately he has not been able to trace the specimens in question so that it must remain doubtful if both species occur in the fauna. Height of average specimen of *nux* from Christmas Island 14 mm., diam. max. 9 mm.

Smith also records the following members of the family—

*Melampus fasciatus* Desh. (Smith 1888)<sup>1</sup>.

*luteus* Q. & G. (Smith 1887).

*castaneus* Mlldff. (Smith 1900).

(I have been informed by Mr. Tomlin since the above was written that he has succeeded in finding specimens from Christmas Island identified by Smith as *scarabaeus* L. and that they are undoubtedly more correctly to be referred to *nux*).

### SUCCINEIDÆ

#### **Succinea solitaria** Smith.

*Succinea solitaria*, Smith, 1887, p. 518, fig. id. 1900, p. 536.

A number of specimens "from jungle".

Two other species have been recorded from the Island; but neither of them is included in Mr. Tweedie's collection.

These are *solidula* Pfr. and *listeri* Smith. The latter has recently been found in Java, whence it is recorded by Miss van Benthem Jutting (1932).

### VERTIGINIDÆ

#### **Nesopupa proscripta** (Smith). Fig. 1.

*Jaminia proscripta*, Smith 1905.

1. These three species were collected in 1932, and have been identified by Mr. J. R. Le B. Tomlin. M.W.F.T.

35 specimens from debris at base of trees.

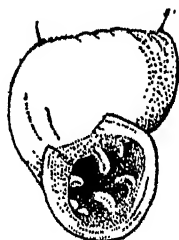


Fig. 1.—*Nesopupa proscripta* (Smith)

Pilsbry compares this species with *malayana* Issel. He remarks—

“This has the angular lamella short, it is remote from, not running into the upper termination of the upper lip, thereby differing from *malayana*.”

#### SUBULINIDÆ

##### *Subulina octona* Brug.

A number of specimens in spirit, without precise localization, along with examples of *Pythia nux*.

Not recorded by Smith, a vagrant.

##### *Opeas gracile* Hutton.

Specimens “from near saw-mills.” I have also seen specimens collected in 1904 from “near Hospital”. Recorded by Smith under the name *Opeas subula* Pfr. I believe the latter name is now reserved for a closely allied New World species or race.

Like the last species this seems to follow in the wake of human activities all over the tropical world.

#### ENDODONTIDÆ

##### *Charopa?* sp.

Seven examples of this interesting shell, some of them much worn.

The largest specimen has a maximum diameter of 2.7 mm. and altitude 1.3 mm.

Shell widely umbilicate, depressed conoidal of about  $4\frac{1}{2}$  whorls, regularly increasing. Periphery subangulate, suture well impressed; aperture sublunate.

Both dorsal and ventral surfaces finely and regularly ribbed.

## TERRESTRIAL MOLLUSCA FROM CHRISTMAS ISLAND

Dr. RENSCH has been good enough to examine a specimen for me and suggests that it belongs to this genus, and is probably an undescribed species.

Whilst I think this is very likely I do not feel able to give a full comparison with the known species of the genus, and therefore leave the specimens without a name for the present.

### ARIOPHANTIDÆ

#### *Sitala* (?) *normani* Smith.

*Ariophanta* (*Microcystis*) *normani*, Smith 1888.

*Lamprocystis normani*, Smith 1900.

*Sitala* ? *normani* Laidlaw 1930.

A number of specimens, some of them very young, were collected by Tweedie. The species seems to be common. Mr. Tomlin writes to me that there are at least half-a-dozen sets of it in the British Museum series.

Its precise generic position is a little doubtful, but it is certainly closely allied to some of the forms at present included in *Sitala*.

Two other species probably closely allied to *normani* have been recorded from the island by Smith, and were included in the same genus (*Lamprocystis*).

These are—

*mildredae* Smith 1888.

*mabelae* Smith 1888.

Tomlin tells me (in litt.) "I do not see any real difference between "*normani*" and *mildredae*. *Mabelae* is flatter and bluntly keeled."

#### *Kaliella cruda* Smith 1909.

"I examined *Kaliella cruda* also, it looks a very ordinary *Kaliella*." (Tomlin, in litt.).

Not represented in the collection before me.

### STREPTAXIDÆ

#### *Huttonella bicolor* (Hutton).

*Ennea bicolor* Smith, (1909).

A 'vagrant' species found over a great part of the Asiatic tropics.

### CYCLOPHORIDÆ

#### *Japonia* (?) *wallacei* subsp.

*Japonia wallacei* subsp. nov. ? Rensch, 1931.

*Leptopoma mouhoti* Pfr. var. Smith, 1900.

Kobelt, Monogr. Cyclophoridæ, 1902.

One worn and damaged specimen. I believe that Rensch is correct in regarding the Christmas Island form as a subspecies, or race of a widely ranging species, forms of which occur from the Aru Islands and New Guinea, through the lesser Sunda Islands to Java, and with a representative in Cambodia (*mouhoti* Pfr.).

The dimensions of the specimen before me are—alt 7.8 mm., diam max. 7.6 mm.

In addition there are three very small, quite immature specimens apparently of the same species.

#### ASSIMINEIDÆ

##### *Paludinella andrewsiana* (Smith).

Several specimens, all dead shells, from fissures in limestone at the top of sea cliff.

Height of average specimen 3.2 mm, breadth 2.1 mm.

Dr. Rensch tells me (in litt.) that this species is clearly very closely allied to his species *P. halophila* from Java. In his account of fresh-water forms from the "Deutschen Limnologischen Sunda-Expedition" (Arch. f. Hydrobiologie, Suppl. Band XIII; 226-227. 1934) he compares *andrewsiana* with *Assiminea bedaliensis* Rensch, but after seeing one of the specimens from Christmas Island he regards it as a *Paludinella*.

#### HYDROCENIDÆ

##### *Georissa javana* Mlldff. Fig. 2.

Numerous examples, from amongst debris.

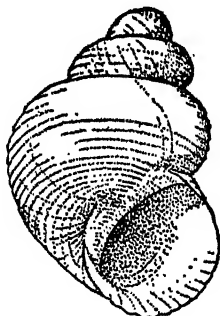


Fig. 2.—*Georissa javana* Mlldff.

This small species appears to be an addition to the fauna of the Island.

## TRUNCATELLIDÆ

**Truncatella valida** Pfr.

This species ranges over the whole of the Indo-Australian Archipelago, and is perhaps the most abundant land-mollusc found in Christmas Island. Dead shells are very numerous amongst debris, and occur at all stages of development. The radula has been figured by Rensch (Zool. Jahrb., 1931, 61: 395, fig. 21).

In an analysis of the fauna the four species of the Ellobiidae and *Truncatella* may be put on one side, they have some special facilities for distribution, and can stand immersion in salt water. There are three species whose presence may be fairly attributed to human agency, viz. *Subulina octona*, *Opeas gracile*, and *Huttonella bicolor*.

The remainder fall into a different category.

*Succinea*.—It is not a little remarkable to find three distinct species inhabiting so small an area. Tomlin has called my attention to the cases, somewhat parallel, of St. Helena with three species of the genus, Bermuda with two, and the Hawaiian islands with a rich development of the genus. This then is a feature of the Christmas Island fauna comparable to that of at least some other remote islands.

The nine remaining species (and with them *Succinea listeri*) all suggest some definite relationship with the molluscan fauna of the Indo-Australian Archipelago, excepting perhaps the *Charopa*. Though it is scarcely possible to write with any degree of certainty as to this species, it is permissible to say that the genus is a very ancient one and is well represented in Polynesia, New Zealand, and New Guinea.

*Nesopupa proscripta* belongs to a genus characteristic of small islands of the Pacific and Indian Oceans. A species is recorded from the Cocos Islands, and even from St. Helena. The Bornean species *malayana* Issel. is closely allied to our species.

The rest of the species may be regarded as belonging to the Malaysian fauna, but with sufficient individuality to suggest a long period of isolation.

In general it may be stated that Christmas Island shows some of the peculiarities, hitherto unexplained, which characterize a number of small islands remote from large land masses.

### NOTICE

We regret to announce that, inadvertently, the text figures illustrating Prof. P. de Beauchamp's paper "*Planares Terrestres du Raffles Museum*" (No. 8, 1933, pp. 109-120) were reproduced on a smaller scale than that intended by the author.

They will be reproduced on the intended scale in this publication at the earliest opportunity.

Editors.



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